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TELEPHONE ENGINEER

VOLUME XXVI MAY, 1922 Number 5

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Radio for the Phone Man

With Radio the Rage the Telephone Man Can Make Good Use of the Simplified Exposition of Radio Telephony Prepared by TELEPHONE ENGINEER'S Technical Editor.

By R. V. Achatz

The widespread interest in the radio telephone that has grown up over the entire country within the last few months has caused many telephone men to investigate this new development so closely related to their own business and to give some thought to the probable effect which it may have upon the present system of communication by wire line. When the telephone man first looks into the matter of radio communication, he is likely to be of the opinion that it is something mysterious and unless he has been prepared by an amateur interest in the telegraph side of radio he will probably regard it as something very complex and difficult to understand. This will be especially true when he meets in the text books a vocabulary of strange words that has grown up around the new art. Wave length, continuous waves, carrier waves, tuners, ticklers, grid leaks, coupling and other radio terms are as strange to the telephone man of today as the terms of the telephone man's language must have been to the telegraph men of forty years ago. However, if the principle of radio transmission and the operation of radio sending and receiving sets can be described in terms with which the telephone man is familiar he will have no difficulty in getting a fair understanding of them and it is the purpose of this paper to attempt an explanation of these things in simple language without going too deeply into the technical question involved.

It is not surprising that a nation that has been developed by the automobile into a nation of gas engineers within the last twenty years; a nation that has been made a nation of practical chemists by the kodak, should adapt itself quickly to the use of the radio receiving set once the difficulty of talking in dots and dashes is removed. There is scarcely more technical skill required to operate a radio receiving set than there is to operate a phonograph and certainly much less than to focus a camera, time the exposure, develop the film and print the picture. Even the transmitting set does not require much greater skill than is required to time the engine, adjust the carburetter or make the many other adjustments that are required in the ordinary operation and maintenance of an automobile. The telephone man will find that the circuits used are much more simple and more easily understood than many of the modern switchboard cord circuits which are being put into central offices by the hundreds. The man whose experience has been entirely with manual systems will find that he must learn a much larger vocabulary of new words when he begins the study of automatic systems than if he takes up the study of the radio telephone. There is little more difficulty in understanding the transmission of radio signals through space than there is in understanding the transmission of voice currents along a wire.

The telephone repeater and the carrier current systems that are becoming more and more common in wire telephony employ many of the same principles as radio telephony and the time is not far distant in which the connection of wire to radio circuits and vice-versa will become as much a part of telephone practice as the connection of wire circuit to wire circuit is today. The telephone man who wishes to keep abreast of developments in his field must know something of both wire and radio systems and telephone engineering is rapidly expanding into the wider field of electric communication engineering. The following sections will attempt to describe briefly some of the principles and apparatus that are involved in this expansion of the telephone art.

Requirements for Radio Transmission.

Reduced to its simplest and most general requirements, it may be said that the transmission of signals through space, or radio transmission as it has come to be known, requires (1) a means of creating some kind of a disturbance (2) a medium in which the disturbance is created and through which it is travels and (3) some kind of a device that is capable of responding to the disturbance as the disturbance travels outward through the medium. A rather crude illustration of these general requirements may be made by considering a vessel or pool of water upon the surface of which at some distance from the center a cork is floating. If the water at the center is disturbed by means of a

plunger which is given an up and down motion, waves are created which travel outward over the surface of the water and as they pass the cork the latter will be given an up and down motion as the water rises in a crest or sinks in a trough. In this illustration each of the three requirements is present and may be observed with the eye. The plunger with which the disturbance is created serves as the transmitting device, the water serves as a medium by which the disturbance is transmitted and the cork float is the receiving device that is responsive to the disturbance in the medium.

Another case where all three of the general requirements are present is in the transmission of sound. If a gong is placed in the center of an open field in which there are no trees, buildings or other obstructions, a man standing in another part of the field will hear the sound of the gong if it is struck with a hammer. In this case the source of disturbance is the gong, the transmitting medium is the air and the device which responds to the disturbance is the human ear. The mechanism of sound transmission is generally understood and no detailed explanation is needed here. It is merely necessary to say that the gong is set into vibration when it is struck with the hammer. The vibrations cause a disturbance in the air near the gong alternately compressing it and relieving the compression. These alternate condensations and rarifactions of the air are communicated to the surrounding body of air and the disturbance travels outward. The sensitive diaphragm in the ear of the listener is set into motion by the air disturbance and the sensation known as sound is produced. The motion of the air back and forth periodically as the condensations and rarifactions occur is called a wave and the disturbance is commonly known as a sound wave. A conventional representation of the condensations and rarifactions of the air is shown in Fig. 1. A definite time is required for the disturbance to travel through the air and experiment has shown that the velocity of sound waves in air is about 1100 feet per second.

An interesting fact in connection with sound waves and one which has a bearing on what is to be said later about radio receiving stations is the occurence of sympathetic vibrations. This is commonly illustrated in the laboratory by means of tuning forks. If a tuning fork is struck by a hammer and is allowed to vibrate momentarily it will be found that an exactly similar fork placed near the first fork will be set into vibration by the sound waves produced by the first fork. If the first fork is stopped, the sound of the second fork will be heard clearly. If, however, the second fork is not a duplicate of the first no vibration will result. The same results may be obtained by means of vibrating musical

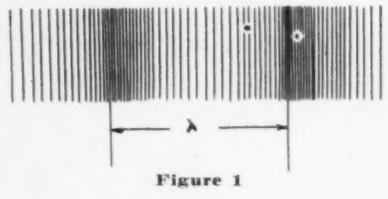


Figure 1

strings. If one string is set into vibration and a second string is tuned to exactly the same pitch it will respond sympathetically. If the tuning of the second string is changed it will no longer respond.

Radio Signals are Transmitted By Electrical Waves.

It has been found that, if certain electrical conditions are set up at one

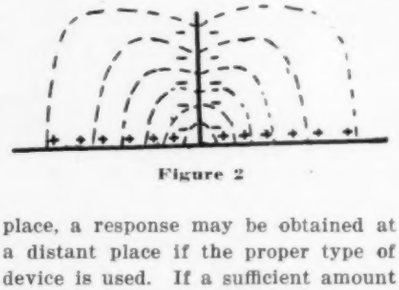


Figure 2

place, a response may be obtained at a distant place if the proper type of device is used. If a sufficient amount of power is used and the device for detecting the disturbance is sufficiently sensitive the distance may be many miles or even thousands of miles. The fact that an electrical disturbance is not limited to the wires in which the current flows is well known. Telephone men have direct evidence of this from their experience with cross talk

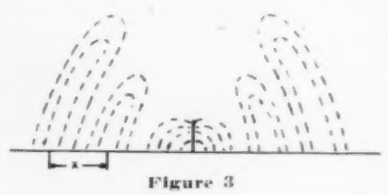


Figure 3

and inductive disturbances in wires that are completely insulated from the disturbing wires. To create such a disturbance some kind of change is necessary in the disturbing circuit, as no disturbance is created when a steady current flows in a wire. The first requirement for radio transmission is present when the proper kind of a change is made in the electrical conditions in the transmitting circuit. The third requirement is met when the proper receiving circuit and device for detecting the disturbance is provided. Since we are unable to conceive of an action at a distance without some intervening medium we are driven to the assumption that some such medium exists to transmit the disturbance. Inasmuch as the action takes place in space from which all air has been removed, it is necessary to assume that this medium called the ether exists in all space whether or not physical matter exists in the space.

Since a change in the electrical conditions is necessary to create a disturbance in the ether, a motion of electrical charges or, what is the same thing, a change in the current flowing is implied. In Fig. 2 a vertical wire is represented as being charged negatively and the earth below it as being charged positively. If conditions are changed so that the negative charges are transferred to the earth and the positive charges are transferred to the wire, a disturbance is created in the space surrounding the wire and an impulse is transmitted outward through the ether. If the charges are transferred back and forth rapidly a succession of impulses are communicated to the medium which travel outward through space. This succession of impulses traveling outward is a form of wave motion just as the motion of the water or the vibration of the air cited above is a wave motion Figure 3 is a conventional representation of a series of radio waves traveling outward from the vertical wire.

A definite length of time is required for the wave to travel from one point to another and theoretical considerations indicate that light waves and radio waves are propagated by the same kind of a motion in the same medium and therefore at the same speed, 186,000 miles per second. When the great Lafayette station at Bordeaux, France, was opened, it was reported that the signals sent out were heard after they had passed entirely around the earth and that the time required to travel around the earth was approximately one-seventh of a second which checks fairly closely with the theoretical speed.

Receiving Stations Must Be Tuned to Receive Signals.

Another indication that the transmission of radio signals is by wave disturbance lies in the fact that the receiving station be "tuned", that is, must be adjusted to the same elec-

trical characteristics as the sending station. It has been found that a condenser which has been charged and is then allowed to discharge through a coil requires a certain length of time before the discharge is completed. If the resistance of the coil is sufficiently low the current does not stop as soon as the condenser is completely discharged but tends to continue to flow and build up a charge in the opposite direction very much as a pendulum bob does not come to rest at the bottom of its swing but swings past to the other side. The combination of condenser and soil has a natural period of discharge and the current will tend to oscillate back and forth at a frequency depending upon the natural period of the circuit. This natural period will depend upon the capacity of the condenser for the larger the capacity the longer it will take to discharge through a given coil. It will likewise depend upon the coil if the capacity is fixed for the greater the number of turns of the coil, the greater its inductance and the greater length of time it will tend to keep the current flowing during the discharge of the condenser. The natural frequency of any circuit may be changed by adjusting either the condenser or the inductance of the coil or both. In the case of the receiving circuit the maximum response to the signals is obtained when the circuit is adjusted so that its natural period is the same as the transmitting set, just as the maxmum response was obtained by tuning the second string to the same pitch as the first in the experiment illustrating sympathetic vibration of musical strings previously described.

All Circuits Are Not Equally Good Radiators.

It has been found that certan arrangements of conductors will send out waves of greater intensity and to greater distances than will other arrangements. If the wire in which the current is caused to reverse periodically, or is oscillating, to use a more commonly used expression, is arranged in a vertical direction and is connected at the top to horizontal network of wires one of the best arrangements is produced. This arrangement, which is called an antenna, is really a large condenser, one plate of which is the horizontal network of wires and the other the earth. Such a system of conductors has a much greater ability to radiate a wave than a loop of wire or an ordinary metallic circuit such as is used in telephone lines where one wire carrying a current in one direction has the effect of neutralizing the radiation from the other wire carrying current in the opposite direction. Likewise, the ordinary circuit carrying 60 cycle current for electric light and power radiates very little if any energy due to the low

Figure 4

frequency while a current in which the oscillations occur at frequencies in the range of 10,000 to several millions of cycles per second radiate considerable amounts. The esential things, therefore, at a radio transmitting station are two capacity areas or plates of a condenser separated by a considerable distance and a means of producing

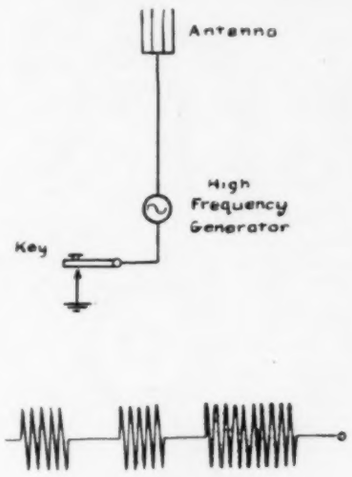


Figure 5

high frequency oscillations of current in the two plates and the wires connecting them.

Fixed Relation Between Wage Length and Frequency.

In the various descriptions of stations and their operation reference is frequently made to the wave length at which the station operates and a brief explanation of the significance of this term may be made here. The length of a water wave may be defined as the distance between two successive crests or two successive troughs created as the waves progress over the surface. Similarly, the length of a sound wave may be defined as the distance between two successive condensations or between two successive rarifications of the air. In Fig. 1 this distance is indicated by the Greek letter *lambda*. In the case of radio waves, the wave length is defined as the distance between two points at which the electrical disturbance is at its maximum in the same direction and is likewise represented by the letter *lambda*, as shown in Fig. 3. Since the wave length refers to stations in all parts of the world it is customary to use the metric instead of the English system of measurement and the wave length is always expressed in meters instead of in feet or yards.

As the speed at which the waves travel does not change there is a constant relation between the frequency of the oscillations at the sending station and the wave length of the waves produced by them. This relation may be understood if the conditions on the surface of a liquid are considered. If the waves travel outward from the point of disturbance at the rate of one foot during each second of time and the disturbance is created by one complete motion upwards and downwards in each second, the wave crest will travel outward and will reach a point one foot from the disturbance just as the next crest is being formed. The wave length will then be one foot. If the disturbance makes two complete motions in one second, the crest will have traveled only six inches by the time the next succeeding crest is being formed. The wave length will then be one foot. If the disturbance makes two complete motions in one second, the crest will have traveled only six inches by the time the next succeeding crest is formed. If the frequency of the disturbance is three per second, the distance traveled by the crest will be four inches. From a consideration of this, the general rule may be drawn that the wave length is equal to the speed of the wave divided by the number of complete oscillations that the disturbing source makes during each second. In the transmission of radio waves the speed is 186,000 miles per second, which is equal to 300,000,000 meters per second, so that an oscillation occurring at the rate of 500,000 per second will produce a wave 600 meters long.

Production of Radio Telegraph Signals.

It is convenient to consider the manner in which radio telegraph signals are produced before discussing the transmission of voice by radio waves. In ordinary Morse telegraphy the letters are are represented by dots and dashes. If the key is held down for a brief period a dot is produced and if

held for a longer period a dash is transmitted. Fig. 4 represents a simple wire telegraph circuit. If the letter "d" is to be sent, the key is held down for a period representing a dash and a current flows from the battery over the line and operates the sounder. This is followed by two depressions for shorter periods representing the two dots. The flow of current over the line is represented by the lines representing the rise of current above the zero line at the right of the figure. Other letters are formed by other combinations of dots and dashes.

The transmission of radio telegraph signals is represented in Fig. 5. The two essential parts of the radio transmitter are shown by the symbols representing the antenna and a generator of high frequency oscillations. A key is connected in series with the circuit and as long as the contact remains open no oscillations occur in the antenna. If the key is depressed, the generator causes oscillations of current in the antenna and waves are sent out as long as the key is held down. If the key is held down for a longer period and then two shorter ones, trains of waves are sent out which persist as long as the key is held down and represent the dash and two dots of the letter "d" as shown to the right of Fig. 5. It is a characteristic of the wire telegraph circuit that signals are produced by the making and breaking of the circuit in accordance with the characters to be transmitted and the radio telegraph system retains this make and break method of producing the character. In practice, however, the circuit is not quite as simple as that shown in Fig. 5 but the principle is the same.

Voice Transmission By Radio Waves.

The transmission of voice by radio may be explained by comparison with transmission over wires in the same manner as the transmission of dots and dashes of the telegraph signals just considered. Fig. 6 shows the essentials of the familiar common battery telephone line. When the transmitter is at rest a steady current flows from the storage battery out over the line and through the transmitter. As soon as the transmitter is spoken into, its resistance varies and the strength of the current varies in a manner depending upon the vocal sound produced. This variation in the strength of the current is represented by the variation in the line indicating the current at the right of the figure. The receiver at the distant station responds to the variations in the current and the sound is reproduced. The transmission differs from the telegraph in that variations of current

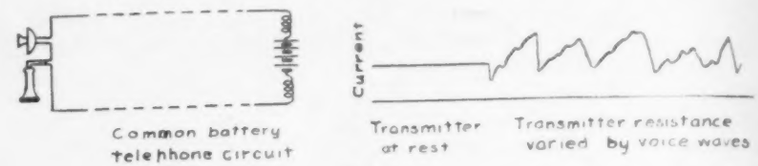


Figure 6

are employed rather than interruptions. In the telephone system the direct current from the battery may be looked upon as a "carrier" of the voice waves and the receiver as a device that detects the variations or separates the voice wave from the carrier.

In the radio telephone system, the transmitter may be used to vary the strength of the high frequency current in the transmitting circuit just as it is used to vary the strength of the direct current in the ordinary telephone circuit. This is shown in Fig. 7 which is similar to Fig. 5 except that the key has been replaced by the transmitter. As the resistance of the transmitter changes due to the action of the voice, the strength of the high frequency current is varied and consequently the amount of energy radiated from the antenna is varied. Thus the electric waves radiated from the antenna serve as a "carrier" of the sound waves as the direct current serves as a carrier in the wire line. If the receiving circuit is adjusted to intercept the radio waves and contains a device to detect the variations and to reproduce the sound waves that correspond to the variations, the radio telephone system is complete.

Figure 7

Reception of Radio Telephone Signals.

In addition to the antenna, the receiving station is equipped with a coil, the number of turns of which can be varied to adjust the electrical constants of the circuit so that it will respond to the particular wave length being transmitted. When this adjustment is made the passing wave sets up in the receiving circuits oscillations of current which correspond to the oscillations at the sending station. If the telephone receiver is connected in series with the circuit no response to the signals will be obtained, however, as the frequency is so great that the diaphram will not follow the variations. It is necessary to provide an additional device, therefore, which will permit a response in the receivers. Referring to the sketch at the right of Fig. 7 it may be seen that the variation of the amplitude of the oscillations is the same on each side of the zero line. If a device can be found which will suppress the current in one direction only the variations on one side of the zero line will remain and while the receiver diaphragm will not follow the individual oscillations, it will follow the change in amplitude which corresponds to the voice wave and will reproduce the sound that is transmitted from the sending station. The same device will serve to reproduce the dots and dashes of the telegraph system.

It has been found that certain crystalline substances have the characteristic that permits current to flow in one direction only and some of these substances may be used. Among the crystals used are galena, silicon and carborundum. A simple receiving circuit using one of these crystals is

shown in Fig. 8. The arrow head indicates the point of a small wire resting on a sensitive spot on the crystal. Current will flow through the detector and receiver when it is flowing in one direction in the antenna but will not flow in the receiver when the current

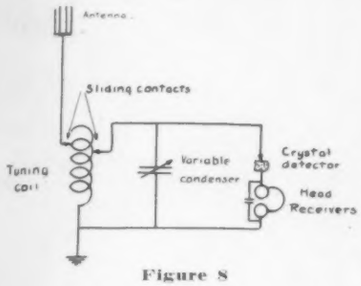


Figure 8

in the antenna is reversed. On account of the very small current produced in the receiving antenna it is necessary to use receivers in pairs and they are wound to a high resistance, usually 2000 or 3000 ohms to the pair.

While crystals act very satisfactorily in detecting strong signals, they are not sufficiently sensitive to detect weak signals from a station at a considerable distance and another type of detector, the audion or electron tube is used which not only acts as a detector but also may be used to amplify the signals. The action of the electron tube will be the subject of a future paper.

List of Books Suggested for Radio Students and Operators.

U. S. Signal Corps. Radio Pamphlet No. 1. Supt. of Documents, Govt. Printing Office, Washington, D. C., 10c.

U. S. Signal Corps. Radio Pamphlet No. 40. Principles Underlying Radio Communication. Supt. of Documents, Govt. Printing Office, Washington, D. C., 55c.

Practical Wireless Telegraphy. Principles and Description of Marconi Ship Apparatus by E. E. Bucher. Wireless Press, New York; $2.25.

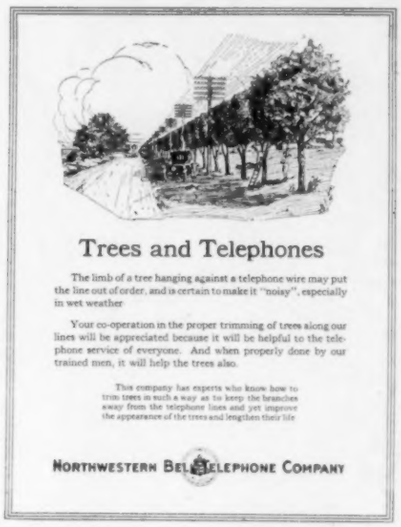
How to Pass U. S. Government Wireless License Examinations. A Question and Answer Book by E. E. Bucher, Wireless Press, New York, 75c.

Wireless Experimenter's Manual by E. E. Bucher, Wireless Press, New York, $2.25.

Experimental Wireless Station by P. S. Edelman, Norman W. Henley Co., New York. (This book has much good information on the practical side of construction), $3.00.

Puts Halt to Tree Trimming Wrangles With Ad.

Omaha, Neb.—Northwestern Bell Telephone Company units are all set for the annual clash with the irate and bullheaded citizens who meet the tree trimming gang with hard words and harder missiles. The Northwestern company speaks reasonably and pleasantly on the subject, in advance


Trees and Telephones
The limb of a tree hanging against a telephone wire may put the line out of order, and is certain to make it "noisy", especially in wet weather
Your co-operation in the proper trimming of trees along our lines will be appreciated because it will be helpful to the telephone service of everyone. And when properly done by our trained men, it will help the trees also.
This company has experts who know how to trim trees in such a way as to keep the branches away from the telephone lines and yet improve the appearance of the trees and lengthen their life
NORTHWESTERN BELL TELEPHONE COMPANY

"Don't Shoot the Tree Trimmer, He's a Talented Gent"—Ad's Plea.

of its crews, by running the accompanying advertisement in a big list of newspapers in its territory. Improvement of telephone service and expert attention to the trees are given the loud pedal in a winning piece of copy.

Telephone Lines Being Built in the Oil Industry.

The Producers and Refiners Corp., of Denver, Colo., has completed and placed in operation a telephone line from the Sand Draw gas field to Riverton, Wyo. The line is along the right-of-way of the company's new gas line. The Midwest Refining Co., also of Denver, and the Producers and Refiners Corp. have built a joint telephone line from the Carbon County gas fields along the right-of-way of their newly completed pipe line about 50 per cent complete. The Ohio Oil Co., of Denver, has completed a line along the right-of-way of its pipe line for gas from Elk Basin to Billings, Mont. Practically every new oil and gas field that is developed means a sudden and often a very large new demand for telephones, poles and all other supplies needed for exchanges outside lines and interconnecting systems.

PHONES AS STANDARD.

Houston Newspaper Cites City's Telephones in Battle of Rival Cities.

Houston, Tex.—The city that has the largest number of telephones installed is the city that is really leading the march of progress, is the thought of the Houston Chronicle.

The Chronicle, in its column "Our City," calls attention to the city's telephone standing by saying:

"Houston has 34,000 telephone subscribers.

"San Antonio, which, according to census figures has the largest population, has only 25,000 telephones. Fort Worth has 24,000.

"Dallas has nearly 40,000, but according to officials of the telephone company, Houston is increasing more rapidly than the North Texas city. Over 3000 phones were added in Houston during 1921, and the applications for new service are coming in at the rate of 500 per month.

"If the ratio of increase is maintained, Houston should have 40,000 telephone patrons by the end of the year, of which probably 25,000 will be in the homes of the city and the remainder in business houses and hotels.

CHICAGO MEET, OCT. 24-27.

U. S. Independent Telephone Association Discusses Sales to Bell Companies.

The Directors of the United States Independent Telephone Association, May 8, decided to hold the annual Convention October 24–27 at Hotel Sherman, Chicago. The treatment given the Association at the convention there last November was such that the Board unanimously declared the 1922 convention should be held at the same place. The Board devoted considerable time to a conference relative to sales of Independent properties to Bell companies. President McKinnon stated that, in his opinion, it was absolutely necessary that some definite procedure be decided upon and a policy announced by the Board in the near future, especially in view of conditions resulting from the proposed sales of the Kinloch company of St. Louis and the Citizens company of Grand Rapids, without notice to or consultation with the association, which is contrary to precedent.

The question of formulating a policy and arriving at the best plan to be followed in such matters was referred to the Executive Committee with instructions to report to the full board at an early meeting.

TELEPHONE ENGINEER'S DATA SHEETS

By J. B. Rathbun

There has been and is now, a demand for a reference work of the loose-leaf handbook form in which data on the more important phases of the telephone industry are given in condensed form. While many handbooks have been published on the subject of electrical engineering in general, there has been no such book exclusively devoted to the specialized information applying strictly to the telephone industry, and it is with an idea of filling the latter niche that TELEPHONE ENGINEER proposes to issue a series of telephone data sheets. This will include mathematical tables, charts, materials of all kinds, testing instruments, operation, etc., and will be collected from authentic sources.

These data sheets, usually run so that four sheets will appear in each issue of TELEPHONE ENGINEER, will be arranged so that they not only will be of service to the electrical engineer and superintendent, but will also contain much matter of interest to the commercial departments and the other branches where cost keeping systems, etc., are of importance. Each sheet will be well worth saving and filing in the special loose-leaf covers which are to be furnished free to each new subscriber or with each renewal of subscription. The compact form of the sheets makes it easily possible to carry this reference work in the pocket.

One of the most important features of the series of sheets is that division which includes the dimensions and specifications of standard telephone materials, a group which will appeal particularly to the draftsman and shop man. Starting in with such simple materials as wire and cable dimensions, properties, etc., the subject is continued into the more complex standard assemblies such as voltmeters and ammeters, line materials, switchboard materials, and many others too numerous to mention. A "glossary" of words, terms and phrases used in the telephone industry will be of great help to the student and beginner in telephony. For the shop man and inspector will be given useful information on "trouble shooting" and similar items, and in short, all possible branches of the field will receive detailed yet concise treatment.

While the subject of radio is not of direct interest to all branches of the telephone industry, yet it will be taken up in some detail for the benefit of those engaged in the manufacturing end of the business, where some work of this nature is usually being undertaken. In time to come, probably every manufacturer of telephones and telephonic apparatus will have more or less to do with the building of radio outfits, and therefore will be interested in developments along this line. In the same way, attention will be paid to the manufacturing features of automobile ignition apparatus and smilar light electrical work.

A complete formulary in which mathematical equations and graphs for the calculation of electrical circuits is a most important feature, both for the engineer and student. Similar formularies for the computation of the economic features of telephony find much space in these sheets, together with authentic data on the factors governing the installation of apparatus and the location of exchanges.

These sheets will appear in every issue of TELEPHONE ENGINEER and can only be obtained by subscribers. For this reason it is important that all intending to keep a full file of these valuable sheets should enter their subscriptions at once in order to avoid missing any of them. Back numbers containing certain desired sheets may be difficult or impossible to obtain. Altogether, there will probably be more than 350 sheets which will run through many months, four sheets appearing in each issue.

INDEXING AND CLASSIFICATION

Owing to the many branches of the telephone industry and the many classes of material and apparatus used, the preparation of a comprehensive index is difficult and was only arrived at after much study. Unless a simple comprehensive system is developed for locating the sheets, and at the same time for allowing intermediate insertions of a special matter, the whole series will be practically worthless as a reference. With this idea in view, we decided upon a system in which each general subject is reperesented by a letter, such as (A), (AA), (B), (BB), etc. Under the various general heads, are the subheads giving intermediate divisions, and these are given a characteristic number. Thus a subhead under the general heading (A) will read (A–12) or (A–8) as the case may be. Following the subhead number will be the page number which gives the order in which the sheets follow under any given sub-head. For example, sheet (5) under subhead (24), and division (A) will read, (A–24–5).

While at first glance, this system may seem rather complicated, yet it is really very simple and flexible and easy to understand after a short experience. It permits the addition or subtraction of various numbers of sheets without disturbing the sequence of either the sheet numbers or subject heads. In beginning the preparation of such a series it is impossible to predict the number of sheets which will come under any one head, hence it is necessary to provide a means of expansion or contraction by which additional sheets may be added or taken away. To allow for the introduction of special sheets and for revisions, the sheets will not always appear in direct numerical number, that is, sheet No. 1 will not always be followed by sheet No. 2. Very often, every other sheet will be skipped at first or even more numbers will be passed over. Thus, if you receive sheet No. 5 and this is followed by No. 8, do not take it for granted that you have missed a page.

In publishing these sheets we will endeavor to skip around among the various subjects, and will not follow any one subject to exhaustion before starting out on the next. This is necessary in order to sustain the interest among the different branches of the industry and so that each branch will be given attention in turn. It is considered advisable to cover as wide a range of subjects as possible in a limited time.

SUBJECT INDEX

In the course of time index sheets will be completed, and will be printed in such form that they can be filed with the other sheets. Owing to the very nature of the proposition it is impossible to give a complete index at the present time, the scope and range not yet being fully outlined, is subject to revision at any time within the next few months owing to certain developments which may take place in the field. The accompanying sheets form the first part of the index and should be carefully preserved.

These sheets will appear in every issue of TELEPHONE ENGINEER and can only be obtained by subscribers. For this reason it is important that all intending to keep a full file of these valuable sheets should enter their subscriptions at once in order to avoid missing any of them. Back numbers containing certain desired sheets may be difficult or impossible to obtain. Altogether, nature of the proposition it is impossible to give a complete index at the present time, the scope and range not yet being fully outlined, is subject to revision at any time within the next few months owing to certain developments which may take place in the field. The accompanying sheets form the first part of the index and should be carefully preserved.

DATA SHEET INDEX (A—1—1)

INDEX TO SHEETS BY GROUPS AND DIVISIONS

(A) INDEX. An index for locating and filing the various data sheets according to the general subject or subject grouping. The letters indicate the general heading, the first group of figures indicates the subdivision under the general heading, and the last figures (To the right) give the page or sheet number. Thus, in C–17–10, the letter (C) indicates that the group is included under Mensuration, and that the sheet refers to the 17th subject under this general head. The last figure (10) is the number of the sheet.

(AA) GLOSSARY OR DICTIONARY of words terms and phrases used in in the telephone industry. Here all of the principal words and expressions are defined, and each expression is followed by the page number on which a more complete description may be found. This of course indexes the sheets name or subject so that the glossary also acts as an index.

(B) MATHEMATICS. Use of Logarithms, Trignometrical Formulae, Slide Rules, General Formulae, Financial Arithmetric, Sinking Funds, Depreciation, Compound Interest, Etc. General Equations of Pure Mathematics.

(BB) MATHEMATICAL TABLES. Functions of Numbers, Squares and Cubes, Logarithms, Trignometric Functions, Decimal Equivalents, Feet and Inch Conversion, Areas and Circumferences of Circles, Interest Tables, General Mathematical Tables.

(C) MENSURATION. Measurement of Length, Area and Volume, Geometrical Forms, Geometrical Construction, General Formulae for Various Figures and Solids.

(CC) UNITS OF WEIGHT AND MEASURE. The Foot, Inch, Meter, Pound, Kilogram, Gallon, Etc., Together With Conversion Tables for English and Metric Measure.

(D) MECHANICAL UNITS. Physical Measurement, Force, Energy, Power, Couples, Velocity, Etc. General Formulae and Tables.

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(DD) CHEMICAL ELEMENTS. Formulae and Tables of Chemical Elements entering into Telephone Work, Sulphuric Acid, Battery Solutions, Etc.

(E) ELECTRICAL UNITS AND CIRCUITS. Elementary Electrical Units, Simple Circuits, Calculation of Simple Circuits; Continuous, Alternating and Oscillating Circuits, Volt, Ohm, Ampere, Etc. Direct Current Formulae and Calculations.

(EE) ALTERNATING CURRENT. Properties of the Alternating Current, Cycles, Self-Induction, Condensance, General Formulae for Alternating Current Circuits.

(F) MAGNETISM. Magnetism, Calculation of Magnetic Circuit, Design of Electro-Magnets, Types of Magnets, Etc.

(FF) TRANSFORMERS. General Data on Transformers and Inductive Resistances, Formulaes and Calculation, Repeating Coils, Amplifiers, Etc., Induction Coils.

(G) GENERATORS. Dynamos and Magnetos, Generation of Current by Magnetic Induction, Motor-Generators, Converters, Ringers, Etc.

(GG) BATTERIES. Primary and Secondary Batteries, Construction, Maintenance, Care, General Rules for Installation, Standard Sizes, Etc., Charging Devices, Automatic Regulators, Etc.

(H) ELECTRICAL MEASUREMENT. Systems and Devices for Measuring Electrical and Magnetic Units, The Voltmeter, Ammeter, Resistance Measurement, Capacity Measurement, Inductance Measurement, Etc.

(HH) WIRE TABLES. Properties of Electrical Wires, Gauges, Materials, Resistance, Capacity, Insulation, General Information on Solid and Stranded Conductors, Copper and Resistance Wire.

COMPILED BY
J. B. RATHBUN

DATA SHEET INDEX (A—1—2)

INDEX TO SHEETS BY GROUPS AND DIVISIONS

(I) INSULATING MATERIALS. Insulation in General, Properties of Various Insulating Materials, Rubber, Cotton, Fiber, Bakelite, Etc., Tables of Standard Materials, Sheets, Rods, Tubes, Etc.

(H) LINE AND HOUSE INSULATORS, Knobs, Cleats, Staples, and Other Insulating Supports, Standard Sizes, Weights, Estimates, Quantity Required, Etc.

(J) METALS, PROPERTIES OF. Copper, Brass, German Silver, Steel, Iron, Etc., Physical and Electrical Properties of the Metals, Castings, Sheet, Tube, Rods, Extruded Metal, Die Castings, Weights, Standard Sizes and Gauges, Commercial Grading, Etc.

(JJ) MATERIALS, PHYSICAL PROPERTIES OF. Physical Properties of Miscellaneous Materials, Methods of Working, Strengths of, Hardness, Ductility, Etc.

(K) BOLTS, NUTS AND SCREWS. Standard Dimensions of Screws, Bolts, and Nuts, Lag Screws, Etc., Tables of Weights, Materials, Standard Threads, Rivets, Pins, Etc.

(KK) TESTING MATERIALS. Standard Tests for Various Materials.

(L) WIRING AND LINE CALCULATIONS. Calculations and Charts for Computing Carry-Capacities of Wiring and Transmission Circuits, Drop of Potential, Underwriter's Rules, Etc.

(LL) WIRING AND LINE MATERIALS. Construction of Pole Lines, Line Materials, Poles, Cross Arms, Insulators, Etc., Standard Dimensions and Tests, House Wiring Materials. Standard Sizes and General Construction, Transposition, Pot-Heads, Underground Construction, Ducts, Conduits, Etc.

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(M) TELEPHONY IN GENERAL. General Conditions of Operation, Elements of the System, General Arrangement of the Circuits, The Subscriber, The Central Office, Relations between the Component Parts, Developments, Phases of Operation, Etc., Organization.

(MM) GENERAL TELEPHONE CIRCUITS. Various Forms of Telephone Circuits, Series and Bridged Lines, Central Energy Systems, Combined Total Circuits, Multiple Board Circuits, Etc., Intercommunicating Systems, Party Lines, Selective Ringing, Circuits in General, Automatic Exchanges, Duplex and Multiplex Systems, Special Conditions.

(N) SUBSCRIBER'S SET. Circuits of Subscriber's set, Elements of Set, The Transmitter, Receiver, Etc., Coin Operation, Details and Standards of Elements, Party line Arrangements, Etc.

(NN) SWITCHBOARD CIRCUITS. Various Types and Arrangements of Switchboard Circuits, Ringing Circuits, Head Set Circuits, Relay Circuit, Circuit of Wire Chief's Board, Etc., Cord Circuits.

(O) SWITCHBOARD APPARATUS. Details of Telephone Switchboard Apparatus, Condensers, Jacks, Plugs, Cords, Relays, Repeating Coils, Etc., Standards.

(OO) MISCELLANEOUS STATION EQUIPMENT. Ringers, Busy Test Sets, Motor Generators, Power Equipment, Power Board Circuits, Miscellaneous Circuits, Storage Battery Plant and Charging Devices.

(P) CIRCUIT CONSTRUCTION. Wiring and Cabling of Switchboard, Cables, Racks, Connections, Switchboard Wiring, Layouts of Cables, Miscellaneous Central Construction.

(PP) SWITCHBOARD LOCATION AND ARRANGEMENT. Layout of Central Office.

COMPILED BY
J. B. RATHBUN

INSULATING MATERIALS (I—1—6)

PROPERTIES OF INSULATING MATERIALS

GENERAL. The purpose of an insulator is to obstruct or greatly reduce the flow of an electric current. Strictly speaking, an "Insulator" or "Dielectric" is never a perfect non-conductor, and therefore some current always flows although this may be a negligible amount taken from a practical standpoint. Compared with the materials commonly known as conductors the resistance of an insulator is exceedingly high, the resistance of the latter commonly being expressed in terms of "MEGOHMS" or millions of ohms. Next in importance to the resistance of its insulator is its "Dielectric Strength," or its resistance to being broken down by high voltages. An insulator may have a high electrical resistance, but if it does not have the requisite dielectric strength it will not withstand high voltages. A third consideration is the "Inductive Capacity' by which the insulator affects the condenser effect or degree of static charge on the parts insulated. The dielectric capacity is widely different in the various insulators or dielectrics and greatly affects the charging current taken by the metal parts of the circuit, particularly when the insulation is very thin and the parts are brought close together.

Air and other fixed gases have a high resistance but a comparatively low dielectric strength or resistance against break down. The resistance of the gases depends upon the pressure and the nature of the gas, a pressure increase increasing both the resistance and dielectric strength, while a diminishing pressure causes them to decrease up to a certain point. Nearly all oils are excellent insulators, particularly the mineral oils, and pure, distilled water offers so high a resistance that it might be considered as at least a semi-insulator. A very slight addition of a soluble salt to water, however, causes the resistance to drop quickly, hence ordinary drinking waters have a comparatively low resistance because of the lime and other salts contained in solution. Practically all gums and resins are very good insulators, rubber, rosin and bitumen being examples. Commercial insulators are usually manufactured products, with the possible exceptions of mica, lava, and quartz, but are usually compounds of the materials already named.

In making comparisons between the resistances of the various insulators, the resistance of common air at atmospheric pressure is taken at unity or at 1,000. In the following table are given the resistances, dielectric strengths, and relative inductive capacities of a number of dielectrics. With the relative inductive capacities, common air is taken at unity.

PROPERTIES OF DIELECTRICS

Name	Resistance in Millions of Megohms per Cubic Centimeter	Relative Induct. Capacity Air = 1.000	Break-Down Voltage	
			Per 0.001 Inch Volts	Per 1.0 Millimeter
Air		1.000	20	
Ambroin	100			10,000
Asbestos	850			4,200
Benzine	14	1.920		
Berrite	22			5,000
Bitumen		2.120		12,000
Celluloid	245			14,000
Coal Tar Pitch				2,000
Ebonite	28,000	2,500		35,000
Fuller Board				
Glass (Flint)	20,000	7.500		12,000
(Ordinary)	90	6.100		10,000
Gutta-Percha	450	3.500		12,000
Litholite				4,100
Mica, Average	80	6.000		22,000
Micanite (Paper)		4.750		18,000
(Cloth)		4.500		17,000
Paper (Common)	0.05	1.500		
(Manila	0.08	1.600	56	
Paraffine		2.300		8,100
Petroleum Oils	10	2.000		
Rubber (Para)	177	2.3000	502	

STORAGE BATTERIES (GG—25—10)

CHARGING AND ELECTROLYTE STRENGTHS

GRAVITY, CHARGE, AND CONDUCTIVITY. Ordinarily, the specific gravity of a sulphuric acid storage battery electrolyte varies between 1.150 at the lowest available point of discharge to between 1.275 and 1,300 at full charge, the latter depending somewhat on the temperature and atmospheric conditions. It is not advisable to discharge below 1.150 nor to carry the density above 1.300, the latter figure being only permissable in cold weather. If installed in a cold place, the battery must be kept well charged during the winter months to prevent freezing.

As will be seen from the following table, the resistance varies irregularly with the density, decreasing with the density up to a specific gravity of approximately 1.215 (29.6 percent acid), and thereafter increasing with a further increase in density. The minimum resistance therefore coincides closely with a well charged condition and the resistance loss is therefore less when kept well charged. The resistance decreases (Conductivity increases) with an increasing temperature, hence the efficiency of the battery is greater at moderate summer temperatures than near freezing point. The following percentages of acid content are based on a concentrated commercial battery acid having a specific gravity between 1.838 and 1.842.

PROPERTIES OF SULPHURIC ACID ELECTROLYTE AT 15° C. (59° F.)

Specific Gravity	Percentage of Acid	Acid in 100 Parts by Wt.	Resistance in Ohms (Cu. Cm.)	Condition of Charge	Freezing Temperature (F.°)	Per Cent SO_3
*1.842	100.0%	100.0				81.63
*1.838	100.0%	100.0				81.02
*1.827	92.7%	92.7	5.3200			
*1.726	81.2%	81.2	4.3370			
*1.638	73.7%	73.7	2.7862			
*1.492	60.6%	60.6	1.5493			
*1.393	50.5%	50.5	1.0861			
*1.348	45.4%	45.4	0.9734			
*1.306	40.0%	40.0				32.65
1.300	39.6%	39.6		Max. Chg.		
1.290				" "		
1.277	37.3%	37.3	0.9300	" "		
1.275				" "		
1.252	34.3%	34.3	0.8743	0.85 Chg.	—50 F.°	
1.231	31.0%	31.0		0.75 "		25.30
1.225	30.9%	30.9	0.8620	0.70 "	—40 F.°	
1.223	30.0%	30.0		0.62 "	—35 F.°	24.49
1.215	29.5%	29.5	0.8300	0.50 "	—20 F.°	23.67
1.206	28.0%	28.0		0.40 "	—15 F.°	22.85
1.198	27.0%	27.0		0.30 "	—10 F.°	22.03
1.190	26.4%	26.4	0.8711	0.20 "	— 5 F.°	21.22
1.182	25.0%	25.0		0.15 "	0 F.°	20.40
1.174	24.0%	24.0		0.10 "	*10 F.°	19.58
1.150				Discharged	*20 F.°	
1.147	20.8%	20.8	0.9730	"	*22 F.°	
1.080	12.0%	12.0	1.3684	"	*25 F.°	
1.053	7.9%	7.9	1.8887	Dangerous		
1.018	2.2%	2.2	5.4712	"		
1.003	0.5%	0.5	16.0110	"	*31 F.°	

(*) Indicates gravity greater than commonly used with batteries.

Here we see that when the battery is discharged down to 1.003 that all but 0.5 percent of the acid has been absorbed by the plates, with an increased sulphation.

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A New "Universal Service"

Telechronometer's Inventor Tells How Invention Works at Everett, Wash.—Says Claim of Increased Service, Economy and Clientele Proved

By Garrison Babcock

The term "Universal Service" has been applied in the past to that service which purports to reach every state, county, city, town and village in the domain, but when so applied there still remains the question of being able to converse with the individual wanted. Therefore the true sense of the term "Universal", in so far as the public is concerned, must reside in the development of local service. To become *Universal* the service must extend to every home and place of business. If the public accepts the idea of "Universal Service" there are only two elements involved in such action. The service must be of such character as to provoke general use and the cost must be within the reach of all. The Puget Sound Telephone Company of Everett, Washington, has already accomplished the first requirement and is now launching the second.

In the year 1915, Everett presented one of the most complicated telephone situations in the entire country. It supported two systems of nearly equal service value, but due to the lack of interconnection, any subscriber who required full service was compelled to install two telephones. In addition to this natural barrier against good service, there existed a court decree which prevented one company buying out the other, and the rural communities were fast developing "haywire phone systems" through which no extended service could be enjoyed. Into this situation, came a young man who had a good record as a "telephone manager" in Provo and Ogden, Utah and Hood River, Oregon, Mr. W. Neal Winter. After securing the approval of the plan by the State of Washington Utilities Commission and the Department of Justice, the competing properties were purchased, which embraced the territory north of Seattle to Bellingham and west of the Cascade range.

Preliminary to undertaking to work out the plan proposed, an engineering study of the plant conditions proved that the capacity of the exchange equipment and building of either of the two acquired Everett systems was too small to accommodate the other, and that the scrapping of these plants and the erection of a new exchange of double size would greatly overload the plant investment and require a return from increased rates which would remove the service beyond the financial reach of many old subscribers. Further engineering study disclosed that by adapting certain automatic features to one of the switchboards, its capacity could be readily converted and increased to accommodate more than double the number of lines and reduce the operator labor to such an extent that much improved service would result, as well as provide a distinct lessening in previous operating costs. The policy of the Puget Sound Telephone Company was then established as follows: "Prompt adoption of any improvement in the Art of Telephony, which will improve service and lower costs to patrons." This slogan has not been extensively voiced but has been religiously practiced to the end that the system has been rewarded with the credit of producing 100% efficient service by its patrons and the state regulating body, the Department of Public Works of the State of Washington.

The first step was adoption of the Synchromomic ten party selective ringing system which enables the ringing of only the party's bell that is being called on multi party lines has largely removed the nuisance which subscribers have heretofore attributed to the economic party line—code ringing—and this applies to the ten (10) party suburban as well as city subscribers.

This was followed by the adoption of the semi-automatic system which is installed in the former Independent Exchange building (Fig. 1) and is said to afford the fastest service in the world, its equipment costing about half as much as full automatic and retaining in service about 70% of the manual equipment previously in service with an increase in its service value of 400%. The equipment is of the relay type and the local switchboard (Fig. 2) has the same appearance as the manual board. The suburban exchange positions have special key equipment shown in Fig. 3. The relay equipment is shown in Fig. 4.

The service through this equipment is superior to the old manual in the following respects: 1. Selection of the

Fig. 1.—General Offices Puget Sound Telephone Co., Former Bell Exchange Bldg., Everett, Wash.

idle operator (instantaneous operator answer). 2. Instantaneous disconnect and recall. 3. Automatic ringing, busy test and ring back signal. 4. Superior transmission. 5 Lower cost of operation. It claims superiority to the full automatic system in these respects: 1. Lower first cost. 2. Lower operating cost. 3. More rapid service in reaching called party. 4. Restores the connecting labor from the subscriber (dialing) to the company. 5. Does not *require* a light for operation. 6. Human intelligence retained at "central" office affords reliability of service as many cases of trouble, which the automatic may hold for days with the telephone out of order, will be located and cleared by the company on notice from the operators. After five years of actual use the proofs of the above statements are available.

The Toll service in the Puget Sound Telephone Company's territory is as efficient as the local. The fact that the average toll revenue per station being approximately double of the average for all systems in the United States and the general satisfaction expressed by patrons is sufficient qualification, but the surprising fact in this connection is that the rates are not those generally established by the Postmaster General during the War. No initial period of three minutes is in vogue. The unit of toll is one minute only and a study of toll tickets shows that the average is about two minutes only. Referring to the Central Exchange illustration, Fig. 2 and 5, it will be noted that in the Everett exchange there are nearly as many toll operators, who give personal supervision to each toll ticket, doing a daily business of approximately 600 tickets or messages as is required in the local service which handles 40,000 calls per day and each message is measured by the Telechronometer system introducing the latest feature, in the telephone field, the Telechronometer.

The Telechronometer system is one which enables the measurement of the telephone service in units of time value. A standard unit of telephone conversation in the Everett exchange is called a "tele" and represents fifteen (15) seconds of time. Four of such units are called a Telechron or, in Everett, one minute of standard time. This may remain the standard for the world if the trial rates now in force prove satisfactory. The hearing on this question before the State Department of Public Works is scheduled for June 6th next.

The electrical and mechanical design and construction of the Telechronometer is simplicity itself. The Central exchange is provided with a time-controlled, noiseless pole changer through which the battery supply to the calling end of the connecting links is carried with the result that only the calling subscribers meters will be actuated (no charge to the called party).

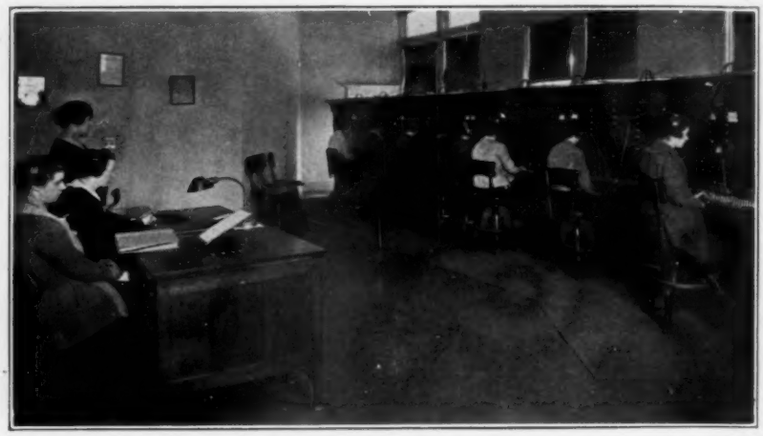

Fig. 2.—Local Operating Room, Puget Sound Telephone Co., Everett, Wash.

At the subscribers station, a small instrument, 4" x 5" x 2½" deep, with register dials, not unlike the gas meter, is installed. This instrument is shown in Fig. 6. The meter movement is of the most simple form and so arranged that to beat the meter the conversation must be cut off. The dials read up to 9,999 minutes or about one week of continuous conversation. It is placed near the telephone as shown in Fig. 7. The installation is so simple and the appearance is so unobjectionable that not a single complaint of its adoption was received from the 5908 subscribers in Everett.

The Telechronometer arrived in Everett in the fall of 1919, being introduced by its inventor, Major Garrison Babcock, who by the way is the man shown in Fig. 7, and after the system had been thoroughly tested by the Company, the Department of Public Works was invited to Everett to examine its operation. As a result, an order was issued by that authority, directing a trial under actual operating conditions. Nine months' observations were made and the Department again invited to inspect the results. The economic promise was such that on June 1st, 1921, the Department ordered the entire Everett system equipped with Telechronometers. This order was complied with and the Telechronometer system was placed in trial service on December 24th, 1921.

Meter readings were first taken for

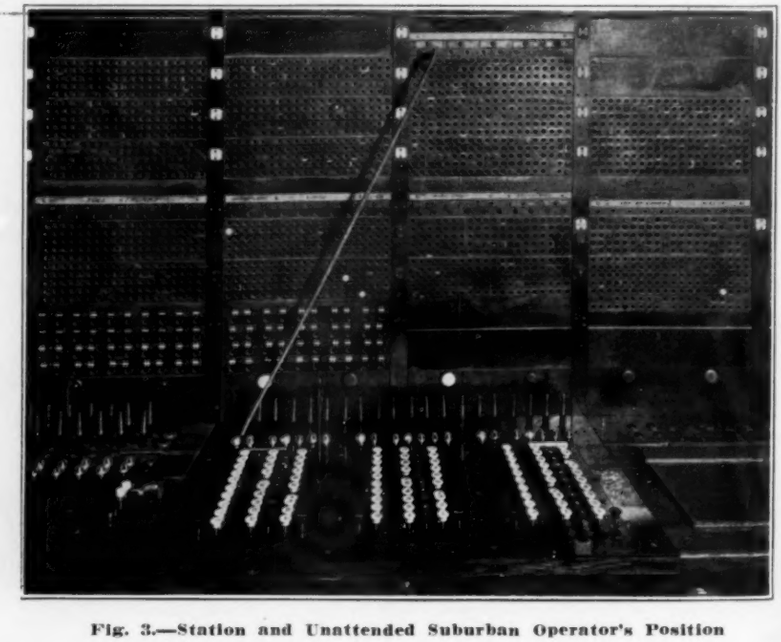

Fig. 3.—Station and Unattended Suburban Operator's Position

one month for originating calls and the second test readings were made showing the incoming service to each subscriber. Thus the first records were established showing the "out" as well as "in" service requirements of telephone subscribers on the unrestricted duration of time basis. The results

Fig. 4.—Telechronometer Relay Equipment, Puget Sound Telephone Co.

of these records indicated that the variation in demand for service as between subscribers to be of astonishing proportions, while the average use by groups as classified by flat rates is much less.

The following facts, covered by one month's outgoing service, are interesting to all concerned:

Business Service Classification:
Smallest user ..... 20 minutes
Largest user .....5720 minutes

Residence Service Classification:
Smallest user ..... 10 minutes
Largest user .....2740 minutes

Taking the groups of subscribers in ten sections composed of users in their respective classifications and it was found that:

10% composed of largest users received their service at a cost of .03¢ per minute, while the

10% composed of the smallest users received their service at a cost of 5¢ per minute.

Under the new schedule of rates based upon the Telechronometer system, all of this discrimination disappears and each subscriber may choose the classification best suited to individual requirements.

The new schedule of rates for Everett showing the result of the Telechronometer change is shown in Table 1.

With the new system of charge ninety per cent of the Everett subscribers will be able to reduce their telephone costs while the remaining ten per cent who are the large users and make the telephone a profitable channel for business have proven themselves willing to pay for what they use. The equity

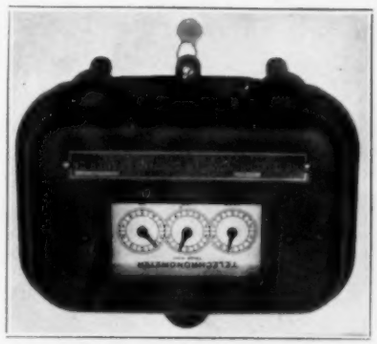

Fig. 6.—Subscriber Station Equipment.

of this method of payment for service on the basis of what is used has been fully established in the other common services, such as water, gas and electricity and there is little doubt of the ready public acceptance of the same principle in relation to their telephone service.

The great economic achievement of Telechronometer is not found however, in equity. As desirable as this feature is, there is a greater reason for its adoption which is both timely and appropriate. This feature is the elimination of the present frivolous and unnecessary load carried by the telephone. Careful observation of thousands of calls give rise to the belief and conviction that fully fifty per cent of the duration of calls will be eliminated by time metered service and when so eleminated will make room for other subscribers on the same plant equipment. This new capacity is made more valuable because the average length of passages will be short and the service "hog" entirely eliminated. In addition to this feature the party line will become vastly more "private" because of the fact that if your neighbor wishes to "listen in" on your calls, *his meter will also register.* Brief use and privacy give a new value to party line service and the low minimum rate (in Everett as low as $1.00 per month) brings the telephone well within the reach of every householder.

Two thousand additional subscribers are available in Everett and will be accommodated without additional plant investment beyond the installation and connection of the instruments at their residences and places of business, because the low rate of $1.00 per month is less than the insurance value to call police, fire, drug-store, doctor or market, and sufficient time use is allowed with the

Fig. 5.—Toll Operating Room, Puget Sound Telephone Co.

CLASS	Present Gross Rate	Proposed Minimum Gross Rate	Decrease	Increase
1 Party, Business	$6.25	$5.50	$0.75	
1 Party, Residence	3.75	5.50		$1.75
2 Party, Business	5.25	3.10	2.15	
2 Party, Residence	3.00	3.10		.10
4 Party, Business	3.25	1.95	1.30	
4 Party, Residence	2.25	1.95	.30	
6 Party, Business or Residence		1.55		
8 Party, Business or Residence		1.35		
10 Party, Business or Residence		1.25		
10 Party, Business, Suburban	4.50	1.50	3.00	
10 Party, Residence, Suburban	2.25	1.50	.75	

The above rates are monthly and are payable in advance. A discount of 25c will be allowed, if payment is made at the office of the company on or before the tenth day of the month for which service is billed.

The telephones supplied under the above rates are of the wall type. Desk equipment will be furnished at 10c per month additional.

Under the above rates, time used is included as follows:

1 Party Lines, 600 Telechrones per month
2 " " 300 " " "
4 " " 150 " " "
6 " " 100 " " "
8 " " 75 " " "
10 " " 60 " " "

Excess use:
First 1000 Telechrones over minimum @ 1 cent
All over 1000 Telechrones over minimum @ ½ cent

Table 1.—Everett Exchange's Rate Schedule.

CLASS	Minimum Net Rate	Telechrones Included	TELECHRONES WOULD COST						
			60	75	100	150	300	600	1000
1 Party	$5.25	600	$5.25	$5.25	$5.25	$5.25	$5.25	$5.25	$9.25
2 Party	$2.85	300	$2.85	$2.85	$2.85	$2.85	$2.85	$5.85	$9.85
4 Party	$1.70	150	$1.70	$1.70	$1.70	$1.70	$3.20	$6.20	$10.20
6 Party	$1.30	100	$1.30	$1.30	$1.30	$1.80	$3.30	$6.30	$10.30
8 Party	$1.10	75	$1.10	$1.10	$1.35	$1.85	$3.35	$6.35	$10.35
10 Party	$1.00	60	$1.00	$1.15	$1.40	$1.90	$3.40	$6.40	$10.40

Table 2.—Relative Cost of Service for Each Class for Different Amounts of Use Up to 1000 Telecrones.

minimum rate to afford this service in the average family or small business.

An addtion to the general value of true "Universal service" to the community, is found in the classified directory. The Puget Sound Telephone Company will extend free classification to all subscribers to the end that every subscriber with a vocation will be registered. This will reach even the day laborer and chore boy. A feature equally appreciated by employers.

In conclusion the route to true "Universal Telephone Service" seems to have been pioneered by one of the farthest west telephone companies, The Puget Sound Telephone Company, through its policy, "Prompt adoption of any improvement in the Art of Telephony, which will improve service and lower costs to patrons".

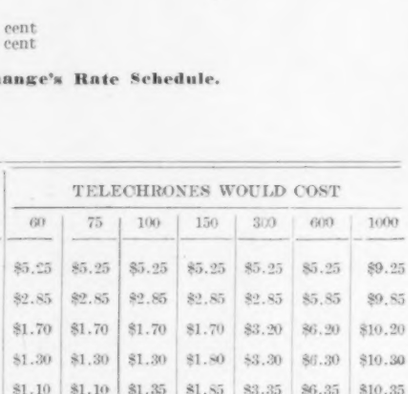

Fig. 7.—Major Garrison Babcock, Inventor of the Telechronometer.

IOWA'S FORUM.

"Free for all" Discussions Feature 27th Annual Convention.

Des Moines, Ia.—A lively, well attended convention, featured by the presence of a goodly number of younger telephone men, sent the 27th annual meeting of the Iowa Independent Telephone Association into history as a success. Under the management of President R. L. Parker of Traer, the open forum plan of meeting brought out spirited discussions. An operators' school added to the practical value of the convention. In President Parker's address he stressed the value of telling the public the cost of supplying telephone service and cited the publication of bank statements as examples of effective education. Tribute was paid the Iowa State College by Secretary Deering, for its co-operation in conducting operators' schools. Mention also was made of the dollar and cents value of association membership, one company telling of help received in an inductive interference case that paid for the company's dues for 20 years.

Inductive interference took up several rounds of the open forum. Such authorities as President F. B. MacKinnon of the U. S. Independent Telephone Assn., J. C. Crowley, secretary of the Minnesota Telephone Assn., and Harold L. Beyer, whose talk begun the discussion, covered the matter from all angles.

Other headline features of the Hawkeye meeting were the remarks of H. W. Hubenthal, the Oklahoma Corporation Commission's telephone engineer, on basing rates on sizes of exchanges, F. M. Lantz, of Clarinda, on Radiotelephony, and R. M. McCullough's practical treatise on pole preservation. F. B. MacKinnon's comments on the problems of telephone companies and J. M. Plaister's handling of "Depreciation and the Interstate Commerce Commission Problem", also figured as bright spots in convention interest.

W. S. Vivian, of Chicago, the high priest of propaganda for telephone companies, instructed the convention in "Telling the Story of the Telephone" to civic bodies of all types.

"Compensation Insurance as It Relates to Legislation" was covered in the address of M. R. Gund of the Employers Mutual Casualty Assn. The efforts being made for closer teamwork between the smaller telephone companies in northwestern Iowa were detailed by W. H. Daubendiek of West Bend.

Interesting exhibits of the manufacturer's newest contributions to telephonic science also registered as one of the convention hits.

The following officers were elected: J. M. Plaister, Fort Dodge, president; D. C. Phillips, Marengo, vice president; Charles C. Deering, Des Moines, secretary-treasurer.

OPINIONS AND COMMENTS

THE LIGHTNING SEASON.

The season of thunder storms is again approaching and the yearly battle of the maintenance force against the lightning damages will commence. We have become so accustomed to burnt carbons, blown fuses, open induction coils, receivers and drop coils that we take them as a matter of ordinary occurrence and we are inclined to give little or no thought to the possibility of improving conditions. The question suggests itself as to whether our protective equipment is really doing what might be expected from it. Several new ideas have been brought forward in recent years in the line of protective apparatus. How widely have they been adopted and what has been the experience with them? There comes to mind a certain exchange of five or six hundred lines where the smallest thunder shower caused a hundred or more blown fuses which means that many lines out of service. Frequently trouble occurs due to poor maintenance of protective apparatus. Failure to clean carbon blocks properly or to replace rough or burned blocks, defective ground connections, shorted fuses, protector blocks left out of the clips or used with double separators all contribute their quota to excess protector trouble. In the average exchange a check-up of these matters before the lightning season arrives will be well repaid by the reduction of interruptions to service during the summer months.

FOR "AULD LANG SYNE."

A group of advertising men were discussing the most effective means of making staunch and influential friends for their companies.

"The best stunt I ever heard of," said a noted publicity expert, "was that of the telephone company in Atlanta, which gave a luncheon in honor of the subscribers who were listed in its first directory.

"Figure the family connections of these old settlers, their local reputations and influence, and the fact that such a luncheon would be a red letter event in the late lives of these guests, and you'll realize that the man who thought of this luncheon was a genius of the first water in creating good will."

"POST GRADUATE" EMPLOYE.

"I challenge any manufacturer present to produce a girl who knows this much about his company's business," said the president of the Minneapolis Manufacturers' Club in commenting on the demonstration and talk of Miss Adelaide Rogers, an 18-year-old operator of the Northwestern Bell's staff. Miss Rogers had finished showing the way in which she and the other operators handled calls. That's a good litle stunt for impressing the community's business men with the calibre and the work of the telephone company's employees.

As the French have it, "Find the woman;" have her stage these "vest pocket" demonstrations before gatherings of business men, and watch good will bloom. The business knowledge of the telephone girl will profoundly amaze the employer of the average run of female labor.

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GATHERING COST DATA

Many times in rate cases it has been felt that the telephone company has not received a valuation on its property that was large enough to represent the true value or the actual amount that had been invested in the property. While engineers have had this feeling, yet, to quote a statement often found in Commission decisions, "no evidence in support of this contention has been introduced." In the absence of cost data, showing what had been the actual cost of doing certain classes of work on specific projects, it has been necessary to rely on the engineers' estimates. Now every engineer recognizes that his estimates are likely to be below the actual cost, as frequently items are omitted, but seldom is anything extra included that would compensate for the error. To offset this he includes an item for omissions and contingencies, the amount of which will depend upon the reliability of the information on which the estimate was based. Opponents frequently affect the opinion that this is an arbitrary and unwarranted addition and make it a pretense to cast doubt upon the correctness of the engineer's figures. If the figures for a number of major items can be substantiated by figures derived from actual costs of those items, the valuation by the engineer certainly will carry additional weight. In other cases, differences in the valuations are caused by the adoption of different bases of estimating. In the Minnesota cases, both the Commission's engineer and the Companies' engineers admitted that, if each had adopted the basis of valuation used by the other, they would have obtained substantially the same results. If data were available, showing the actual cost in a number of cases, the adoption of one or another basis of valuation might be shown to be justifiable.

The lack of such definite cost data in the telephone field is explainable by the fact that telephone companies build for their own use rather than for sale, and the need of an accurate cost ac-

counting is not so great On the other hand, there are many cases where accurate informations as to actual unit costs would be of great value as in accounting—for in estimating the cost of extensions and reconstruction, and in the cases mentioned, where valuations are involved. Companies having such data have an advantage over those who do not possess them. It is too late to gather data on past construction but a start can be made by collecting cost information on present jobs by continuing this practice on all future work. It should be possible to work out systems which will give the unit costs of different plant elements without requiring too much clerical labor and expense, and a little extra effort in this direction will be well worth while.

RATES AND THE WAGE SCALE.

In commenting on the earnings report of the American Telephone and Telegraph Co. for the first three months of 1922, President H. B. Thayer calls attention to the wage and employment situation with that company. He says that the policy "in advancing wages during the feverish period following the war only to such a level that we expected to be able to maintain, has amply been justified by the results. We have a more permanent force, working more efficiently than ever before, which is reflected in a higher standard of service, coupled with economies of operation already realized"

The editors of this paper repeatedly have stated their opinions that the time for any general reduction of telephone rates has not yet arrived and they believe it is doubtful if it ever will arrive, unless some unforseen change of radical character occurs in economic conditions in this country. One of the reasons for this belief is the important place of the item of wages and salaries in the cost of telephone operation. Statistics compiled several years ago show that sixty-seven per cent of the operating costs in the telephone business is due to wages and salaries, and it is certain that this percentage has not decreased in recent years. Telephone managers are interested in giving the highest quality of telephone service. The public is interested in getting, and it is willing to pay for, this class of service. Good service will not be maintained nor will the plant be operated economically by a staff of underpaid and dissatisfied employees. Both traffic and plant forces have been underpaid rather than overpaid in the past and the increases granted during the recent period of inflation were not as great as those given in many other industries. It is of advantage alike to the employee, the company and the public that a wage scale be maintained in the telephone field that will result in a permanent and efficient working force. An attractive wage scale, coupled with the inherent interest of the work, not only will keep the best talent that is at present employed in the business but will attract a higher grade of new people who will become the workers of the future. Telephone rates must be left at a place that will provide a decent livelihood for those who work in this field; at a point that is, sufficient to provide wholesome f o o d, comfortable clothing and cherful housing, as befits the station of these workers in life. Also, they must have a sufficient surplus to lay away something against their future needs as well as to provide some enjoyment of the higher life. It must be remembered that the moral right of the worker to these things is superior even to the right of the stockholder to a return on his investment. The ultimate result of the continuance of such a wage policy in the telephone business will be greater satisfaction to the employee, greater economy of operation to the company and better service to the public.

NEWS VALUE OF CONSTRUCTION WORK.

Telephone companies frequently overlook the fact that their construction work has real news value and can be made to produce an effective kind of publicity. Almost any piece of construction work forms a news item which local papers are glad to print and if interesting details are added may serve to acquaint the public with certain phases of the telephone business better than is possible through paid advertising. The news gathering force of a local paper can not be expected to supply these details. To the average reporter, a job of underground construction, for instance, is only a gang of men working in a trench in a certain street. Two or three lines will tell the whole story as he sees it. If the telephone company, however, will supply the information a much more complete story can be written. It may be explained that the conduit is not laid for immediate needs but is planned to take care of future growth as well. The number of pairs in the cables and the total length of conductors may be given. The relative cost of underground and aerial construction and the effect of placing the cables underground or the amount of trouble on the lines and other information can be supplied. All of these matters have a legitimate news value and if they are properly woven into the story the reader can be left with the impression not only that certain work is being done but that the work is a part of a definitely planned program of improvement which will result in a constantly improving grade of service to himself and other users. Any other type of construction work will furnish an equally good story and it is just as important that full advantage is taken of this kind of publicity as it is to see that well written advertisements are supplied for the space that is paid for.

THE WILLIS LAW.

In certain quarters there seems to be some uneasiness as to the policy of the Bell System in the matter of absorption of Independent systems. The passage of the Willis law authorizing the Interstate Commerce Commission to permit the consolidation of competing telephone companies had the immediate effect of clearing the way for removing the competition which had existed previously in Ohio. Instead of a division of territory, the outright sale of the Ohio State Telephone Company to the Bell interests became possible. This has been followed more recently by the announcements of the sale of the Citizens of Grand Rapids and the Kinlock of Saint

Louis, indicating that the general policy of the Bell had changed from one of division of territory to one of outright purchase in cases where important competition still existed. The question naturally arises as to whether the ultimate results of the passage of the Willis bill will be the creation of a monopoly of the telephone business in the hands of the American Telephone and Telegraph Co. The present state of opinion regarding public utilities is that there should be a single utility under state regulation operating in each community and in the case of the telephone utility that each local plant should be connected to the nation wide long distance system for universal service. It does not follow, however, that all of the local exchanges should belong to the same owners thus forming a complete monopoly of the business. There are many who believe that it would be but a short step from the formation of such a monopoly to government ownership, in spite of the unsatisfactory results of government operation of the railroads and wire lines during the war period. The United States Steel Corporation seems to find it desirable to have a number of strong independent steel companies in the business of manufacturing steel products and it is reasonable to suppose that the Bell system would find it of advantage that a considerable percentage of the telephone business continue to be handled by well managed, independently owned companies. It is not likely that the Bell officials are making the mistake of assuming that the the public's consent to consolidation of local competing plants in order to be rid of the nuisance of dual telephone service indicates a change in that attitude of the public toward monopoly which brought about the passage of the Sherman law. It is to be expected that the policy of purchasing competing properties in the larger cities will be continued until all competitive situations are removed and it is possible that some of the larger companies to which the Bell has sold in the past may be absorbed. On the other hand, Bell officials will admit that they can not collect rates that would prevent them from operating at a loss in the smaller communities where locally owned and operated companies are carrying on the business successfully. Between the large cities and the rural communities is a vast number of moderate-sized towns and cities which the Bell would undoubtedly like to have but which they are willing to leave in the hands of local companies if the latter can carry on successfully. Whether or not such systems will be absorbed will depend much upon the owners of these systems. If they desire to get out of the telephone business, they can probably find a purchaser in the Bell subsidiary operating in their territory. If they desire to continue in the business, there seems to be little in the present situation to cause fear. The best advice for those responsible for the management of such companies would seem to be to go on with the business, to manage it in such a way that the stockholders and the public are satisfied, and to stop worrying.

"Operator, Draw Budweiser 250."—Berlin Idea.

Berlin, Germany.—A new system of naming telephone exchanges has been devised by the government in its campaign for raising money by every possible means. Rights to name telephone exchanges will be sold to advertisers making the highest bids. It is predicted liquor manufacturers will make the most of this opportunity. This idea is a development of the policy in vogue at the post office where the purchaser of stamps, or the individual mailing letters is urged to buy products advertised at the postal stations.

A VISIT TO WARREN.

Or a Kellogg Story From the Layman's Viewpoint.

We invite you to visit a new Kellogg-equipped exchange at Warren, O., where they have today 4625 telephones connected with a Kellogg Service switchboard. When you ask a layman what he likes best about telephone service, he will say, "Immediate connection, good transmission and reliable ringing." Kellogg Feature Service means secret service, prompt disconnect and recall. How many, many times have you been "hung up" when, no matter how much rattling of the switchhook or cussing, you still get no reply? That is guarded against with a Kellogg Service Switchboard.

In Indiana, we find many successful switchboards making money for their owners, prominent among them being Wabash. You hear a good deal about machine switched equipment, nowadays. Kellogg is making some automatic equipment, but any kind of telephone connecting requires some intelligence to do the switching. Kellogg Service switchboard is claimed to be the most automatic of all from the subscriber's standpoint, because there is the least for him to do; the mental part is minimized and confined to a very few operators. There are hundreds of Independent telephone companies in Indiana; some 600 or 700 in Wisconsin, even more in Illinois and Ohio.

Warren, O., illustrates graphically, the value of Kellogg equipment. The operators at Warren answer 400 calls an hour and think nothing of it. People in Warren never have to wait for the operator, nor do they, it is said, in any other Kellogg Service exchange. The reason is that when you lift the receiver from the hook, your signal is before at least three operators and one of them gets it immediately. The switchboard is not complicated; you cannot see much going on, nevertheless there is a great deal being accomplished easily and quietly. The commercial and social life of the thriving city lies before us, but all we see is a few operators inserting plugs in small holes. The details of Automatic Ringing, Instantaneous Recall and Disconnect, Secret Service and Register peg count are all taken care of automatically by means of relays just the same as in a machine switched exchange. In the automatic exchange, the subscribers do not work and, doing it not so often or so fast, cannot, Kellog claims, be as efficient as the skilled operator who when your lamp lights before her, inserts your plug to connect your line while another plug connects the line of the party to whom you wish to speak, with the least possible delay. The operator is automatically cut out and cannot listen to either subscriber until one of them hangs up his receiver. The manager at Warren says one month the average number of calls answered per position operator, per hour, was 374, and the average number of calls answered per position operator during busy hour (peak of the telephone load) was 410.

PRACTICAL PLANT PROBLEMS

CHAPTER III

By Charles W. McKay, Associate Editor

Foreword as to Construction Problems.

To diverge, for a moment, from the present phase of our consideration of the subject "Practical Plant Problems"—it may be well to emphasize the fact that this Department, and series of articles, contemplates not only the presentation of the theoretical phase of plant engineering, but also practical working suggestions for laying out new plant; rehabilitating old plant, and the preparation of plans and specifications incidental thereto. Furthermore, after we have concluded our consideration of the strictly engineering portion of the subject—actual construction problems will be discussed in some detail.

At the outset of this series, it was stated that one of the prime objects of the series was to afford practical aid to the executives of the smaller telephone companies in solving their own plant problems. Frequently the manager of a small telephone company has occasion to construct small quantities of underground conduit plant; install underground (and sometimes even sub-marine) and aerial cables. Obviously, experimentation in telephone construction work is expensive. It is also expensive to retain outside construction specialists—where small quantities are involved. Hence, in connection with this series—after we have concluded the consideration of our present subject of Plant Engineering—it is proposed to treat, quite exhaustively, the more strictly construction phases of the subject suggested by the title of this department, "Practical Plant Problems."

In considering the construction problems, an effort will be made to present in a clear, concise manner the most up-to-date methods of conduit construction, underground, submarine, and aerial cable installation, etc. For the benefit of the readers of this series who are not practical plant men, the subjects of pole line construction, aerial wire installation, etc., will also be discussed in some detail.

Review of Plant Engineering Procedure.

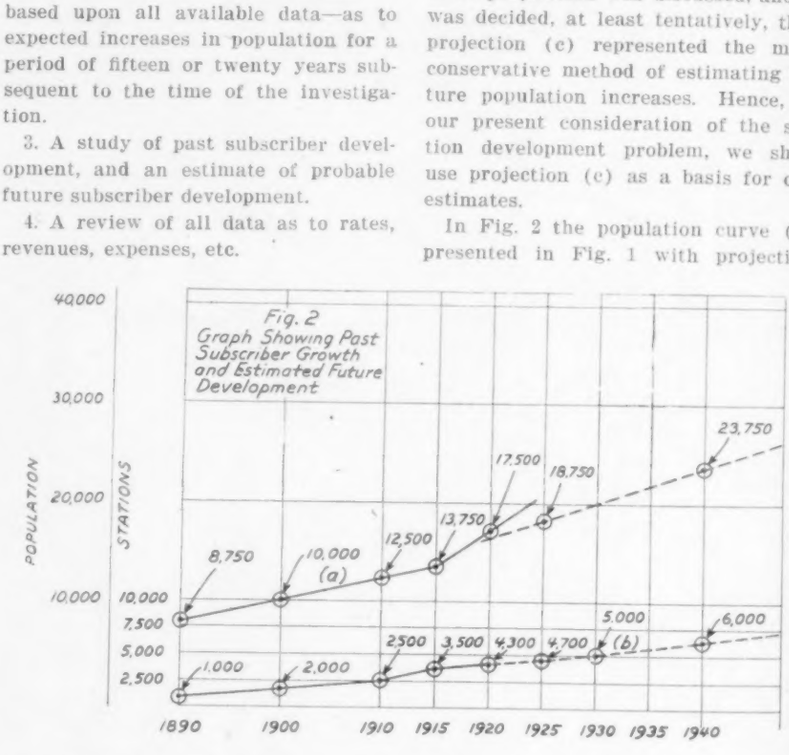
To return to the present phase of our subject—in the last installment of this series, a "specification" was suggested covering the work to be performed by the plant engineering specialist. To review, briefly, this specification called for procedure in the following manner—and in the order enumerated:—

1. A consideration of the character of the community in question—from a commercial standpoint.

2. A study of past and present population statistics—and an estimate—based upon all available data—as to expected increases in population for a period of fifteen or twenty years subsequent to the time of the investigation.

3. A study of past subscriber development, and an estimate of probable future subscriber development.

4. A review of all data as to rates, revenues, expenses, etc.



5. The careful study of the existing telephone plant and equipment—with a view to determining its limitations, and also its adaptability to future development plans.

6. The preparation of the Development Study.

7. Preparation of the Fundamental Plan.

8. The preparation of detailed plans and specifications for construction work—based upon the data resultant from operations 1 to 7 inclusive.

The first two operations were discussed in the April issue. The modis operandi in performing the third "operation" is very similar to the methods suggested, in the last installment, for forecasting the population increases. In Fig. 1 (in the April issue) the population data was plotted for the years 1890 to 1920 inclusive—the latter being the assumed date of our investigation. With the aid of this data, projections (a), (b), and (c) were made of the population curve. The method of determining each of these projections was discussed, and it was decided, at least tentatively, that projection (c) represented the most conservative method of estimating future population increases. Hence, in our present consideration of the station development problem, we shall use projection (c) as a basis for our estimates.

In Fig. 2 the population curve (as presented in Fig. 1 with projection (c) is reproduced. Fig. 2 also shows the number of stations in service for the years 1890, 1900, 1915, and 1920.

It has been assumed that the company, whose problems we are considering, was a comparatively new one at the beginning of our analysis period—the year 1890. At that time, there were approximately 1000 stations in service. Ten years later, in 1900, there were 2000 stations in service—while the population in the year 1900 was approximately 10,000. It will be noted that the growth during the ten year period has been exceedingly rapid—100% to be exact—and that the

ratio of stations to population is one to five.

In the year 1910, it will be noted that the company had 2,500 stations, and that the population of the town was 12,500. We still have the ratio one to five—or in other words, what is termed—in telephone engineering parlance—a "twenty percent development." Five years later, in 1915, we have approximately 3,500 stations, with a population of 13,750, and in 1920 we find 4,300 stations, and a population of 17,500. For both of these latter periods (the years 1915 and 1920) the ratio of stations to population is one to four—or, in other words, we have a "twenty-five percent" development. All things considered, a twenty-five percent development is not abnormal for a town of the size and character of the one we are considering in our hypothetical case. The writer can cite a number of instances, where he has been called upon to make development studies, where the ratio of stations to population was even higher than the "1 to 4 ratio." All of these cases are comparable to the one under consideration. In other words, the respective populations ranged from 15,000 to 20,000 and the "commercial" characteristics of the towns were comparable to the assumed commercial characteristics of the town under consideration in the present illustration.

Referring to Fig. 2, again, the upper curve (a) presents the population data, while the lower curve (b) presents the station data. It will be noted that dotted lines, in both instances, have been used for the projections beyond the year 1920. In view of the fact that a twenty-five percent development has prevailed for the years 1915 to 1920 inclusive—and furthermore, that this development is a normal one for a town of the commercial characteristics assumed in the illustration—the same ratio (the ratio of one to four) has been used in projecting the curve (b). From this projection, we find that we may expect approximately 4,700 stations in the year 1925; approximately 5,000 stations in the year 1930, and approximately 6,000 stations in the year 1940.

So much for the third operation in our plant engineering study. Later, we will see how the resultant data may be used in connection with the development study, fundamental plan, etc.

Review of Revenue, Expense and Rate Data.

The next step in our "Engineering specification" involves the review of all data pertinent to revenues, expenses, rates charged for service, etc. The reason for this will be obvious, when it is remembered that—if plant rehabilitation, reconstruction, or extension is necessary—additional funds may be required. Furthermore, the development studies may disclose the fact that a reclassification of service is necessary. The writer has known of instances where it was possible to affect a postponement of plant rehabilitation by making a careful study of the classifications of service—and using this study as the basis for regrouping subscribers, thus providing temporary relief.

If it is necessary to raise money for plant reconstruction and enlargement, obviously, it is most important that all revenue, expense and rate data shall be thoroughly analyzed. Furthermore, a plant valuation may be necessary as collateral evidence for "proving-in" the case to investment bankers.

This phase of the engineer's problem—the review of rates, revenues and expenses—is important but it is thought that a detailed discussion may be presented, to better advantage, after we have considered the remaining steps in the "engineering specification."

Examination of Existing Plant.

The fifth operation, in the engineering analysis, involves a careful study of the existing telephone plant. Such a study is made for the dual purpose of familiarizing the engineer with the plant "as is" and of providing detailed data as to the adequacy of the existing central office, feeder and distribution facilities.

In connection with the fifth operation, a map should be prepared showing the exact location of all central offices, conduits, man-holes, aerial cables, pole lines, and open wire leads. After the map-record has been completed, each individual unit should be analyzed—as to spare facilities, defective (cable) pairs, etc. The conduit system, also, should be scrutinized and a record made of available spare ducts, unused lateral ducts, etc.

In a similar manner, a careful analysis should be made of central office facilities—both as to the central office equipment itself, and as to the space available for enlargements or extensions. In connection with this analysis, a careful study should be made as to the present condition of all central office equipment—both from the standpoint of accrued depreciation (wear, tear and use) and from the standpoint of obsolescence and inadequacy.

This fifth operation, in our engineering analysis, is most important—for obvious reasons. It frequently happens that a little "engineering"—especially directed toward the solution of the problem of making maximum use of existing facilities—will go a long way toward providing necessary relief. Obviously, engineering work of this nature is inexpensive, and, if it produces the desired results, appreciable monetary savings—from the standpoint of investment in new plant and equipment—are bound to result.

The Development Study.

The next step in the engineering analysis is the development study. The development study may be divided into two operations:—

(a) The "house-count" study.

(b) The transcription of the data resultant from the house-count study to maps, of suitable scale, representing the entire territory under analysis. These maps should also contain a record of the existing plant showing, or directly referring to, the analysis of present plant facilities—as described in the fifth operation.

Before proceeding with a discussion of the house count study, it may be well to pause, for a moment, and consider the purpose of the development study—as a whole. The purpose may be summarized under three captions, as follows:

(a) The determination of an accurate record of existing telephone development. This phase of the study should show the location of all subscribers and their respective service classifications; i. e. single, two and four party residence, and single, two and four party business, private branch exchange, etc.

(b) The determination, as accurately as possible, of the expected telephone growth during the first five years subsequent to the date of the investigation and the expected telephone development at the end of twenty years from the date of the investigation. The prognosis of expected development should include a service classification. In other words, the estimate should be so planned as to provide, at least approximately, the following data:

1. Estimated number of single party stations at the end of five year period.
2. Estimated number of two party stations at the end of five year period.
3. Estimated number of four party stations at the end of five year period.

The data suggested in the foregoing enumerated paragraphs should be subdivided under the captions "residence service" and "business service."

A similar estimate should be made for the twenty-year period.

(c) The final step in the development study includes an estimate of the telephone facilities—central office, underground cable and conduit, aerial cable, and pole line—required (first) during the five year period and (second) between the end of the five year period and the "ultimate", or twenty year, period.

In connection with the terms "ultimate period" (the twenty year period) and "ultimate requirements", it may be well to call especial attention to the fact that ultimate requirements must, of a necessity, be based upon estimates. It is the duty of the telephone engineer to make use of enlightening data, from all available sources, and if he is "on to his job", his estimates should result in a reasonably accurate forecast of future requirements. However, it should be remembered that the judgment of even the best, and most experienced, telephone engineers is not infallible. Unforeseen circumstances may arise which will have a very material effect upon the "trend" of telephone development. Telephone engineers are not the only ones affected by unforeseen contingencies in municipal growth. The writer has known of many cases where real estate operators have speculated heavily—basing their speculations upon seemingly sound hypotheses—with respect to the future development of certain communities. Subsequently, due perhaps to a popular whim, or possibly to more tangible reasons—the trend of municipal development has been entirely changed, within a comparatively short period, involving heavy monetary losses.

This preliminary discussion of the development study should suffice to give the reader an idea of the importance of the development study as a function of the complete engineering survey.

Preliminary Steps in House-Count Study.

Taking up a detailed consideration of the house-count study—the writer would suggest the following preliminary steps.

If the town, or city, under consideration is a large one, secure an individual map for each city block. Such maps should be of a scale of approximately 200 feet to the inch—and may usually be obtained by making tracings of the maps contained in insurance atlases. The buildings—residences or business blocks—should be indicated upon the "block" maps. Obviously, for our purpose, it is not necessary to indicate the plan outline of the buildings in detail. A suitably scaled "square" or "oblong" will suf-

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

of TELEPHONE ENGINEER, published monthly at Madison, Wis., for April 1, 1922.

State of Illinois, County of Cook, ss.

Before me, a notary public, in and for the state and county aforesaid, personally appeared W. H. Graffis, who, having been duly sworn according to law, deposes and says that he is the general manager of TELEPHONE ENGINEER and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, general manager and business manager are:

Publisher, TELEPHONE ENGINEER, Madison, Wis.

Editor, Herbert Graffis, Chicago, Ill.

General Manager, W. H. Graffis, Chicago, Ill.

Business Manager, Jos. M. Graffis, Chicago, Ill.

2. That the owners are (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholder, owning or holding one percent or more of the total amount of stock):

W. H. Graffis, Herbert Graffis and Jos. M. Graffis, all of 28 E. Jackson Blvd., Chicago, Ill.

3. That the known bondholders, mortgagees and other security holders owning or holding one percent or more of total amount of bonds, mortgages, or other securities are (If there are none, so state).

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustees or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full known and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any person, association or corporation has any interest, direct or indirect, in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date above, is..... (This information is required from daily publications only).

TELEPHONE ENGINEER,
W. H. Graffis, Gen. Mgr.

Sworn to and subscribed before me this 23rd day of March, 1922.

(Seal) M. A. STEPHEN.

(My commission expires Sept. 1, 1925.)

BELL'S NEW QUARTERLY.

Digest of Suggestions and a Record of Progress Now Published.

New York City—In April, the first issue of the "Bell Telephone Quarterly" was printed. Its editorial policy, as announced by President Thayer, is to act as a medium of suggestion and record of progress on matters usually discussed between presidents and general managers of Bell companies. The April issue has articles on the Radio Telephone Situation, by A. H. Griswold; Work of the Bell Telephone Securities Co., by D. F. Houston; The Telephone's Development, by J. J. Carty; Some Notes on Statistics, by S. L. Andrew; Progress of the Joint Committee on Relations of Supply and Signal Circuits, by Bancroft Gherardi.

Telephone Use Shows Industry On Up Grade Again.

New York City—J. S. McCulloh, president of the New York Telephone Co. tells New York newspaper interviewers that the toll and local telephone business during the last few weeks indicates a substantial revival in business. In April, the million mark was passed in New York installations, and at the time the interview was given, there were 87,000 unfilled orders on the company's books. The Western Electric Co. plans to make more than 900,000 telephones this year.

Babcock's Telochronometer Gets National Free Publicity.

Chicago, Ill.—Major Garrison Babcock's invention for metering the time of telephone conversations is getting "press agent" notices of a valuable character "free, gratis, and for nothing". One of the news photographic services is selling pictures of the device by the scores to newspapers for reproduction. Editorial comment on the device is generous. The Cincinnati Post says the device "might serve a useful purpose in curbing idle gossiping among girls and women", in an editorial on "Phoning" inspired by the Babcock invention.

Sidney, O., Company Another to Use Radio Service

Sidney, O.—One of the most powerful radio stations in this section of Ohio is being installed at the new plant of the Sidney Home Telephone Co.

Safety Plan That Works O.K.

Illinois Bell Telephone Company Outlines Method of Operating an Accident Prevention Campaign that Gets Whole-hearted Co-operation of Force—Foremen Head it.

Why does accident prevention get a place of prominence in present day telephone plant work?

1. We are responsible for reducing the hazard of our business to a minimum.

2. We can improve our production by the training for prevention of accidents to avoid waste of man power.

3. We can improve the morale of our force by a brotherly interest in their welfare which results in their interest in our company.

4. Our interest in our good name and the public good will make it desirable to safeguard our employees from injury.

5. We can contribute to the progress of accident prevention ideals and further assist promoting general public safety.

We are responsible for safeguarding the community we serve from injury from our plant. The State has emphasized this responsibility by laws and regulations affecting the safety of the public and the protection of our employees who are injured in their work. The stockholders, whose servants we are, hold us responsible for protecting them from loss of money or good name by minimizing the hazards of the business. We are responsible to our employees for safeguarding them while they perform their duties. Production economy depends chiefly upon getting a day's work for a day's pay. The prevention of accidents insures us largely against unproductive time. Morale of our force is directly related to our production and results in loyalty which gets the job done well, renders good service and satisfies our subscribers. The good name or reputation of our business is as important to its success as personal reputation is to the success and happiness of the individual. Above our good name is our character, the spirit in our business which is aside from any economical consideration. Our training in accident prevention is reflected in the habits of the families of our employees. This influence radiates to the community and continues to prevent accidents in the generations to follow.

Accident Prevention Activities—Their Objectives.

How can we best accomplish these desired results? The prime requisite is for the executive to thoroughly recognize that he is responsible for accident prevention in the same way that he is responsible for good workmanship, quantity of production and economic use of time and material. The objectives to be realized as a result of this responsibility are:

1. Prevent accidents as far as possible.

2. Minimize as much as possible the effects of accidents which do occur.

The first of these objectives divides itself into three principal headings:

1. Physical safeguards to plant involve constructing and keeping existing plant free from hazards and keeping the equipment and tools in such a condition to avoid unsafe working conditions.

2. Safe methods of doing the work, standardized and specified in such a manner that the job may be done at the least risk.

3. Training the force, in individual safety as a habit of thought by developing forethought, caution and bodily safety in action should be supplemented by impressing on foremen and workmen their responsibility for accident prevention and keeping their interest alive by competition.

Analysis of all accidents which occur assists in bringing to attention physical hazards, unsafe working conditions and need for further training. The second major objective, the minimizing of the effect of the injuries that do occur involves,

1. First aid.

2. Efficient subsequent medical attention for prompt and complete recovery.

3. Alternate work during the period of convalescence. Work that will not cause pain or retard recovery but which will secure some production gives the employee valuable experience and keeps up the morale of the injured.

Some Physical Safeguards To Be Observed.

To avoid physical hazards it is the responsibility of those in charge to see that plant is built safely, inspected periodically and maintained to prevent accidents. Natural causes result in slack wires which may result in contact with power leads and serious shock to workmen or may result in insufficient clearance of a railroad and drag a brakeman from a train. Everyone of us is sufficiently familiar with such conditions as rotten poles, unlighted stairways, doors opening into passageways, exposed nails, etc. that it is unnecessary to attempt to catalogue them or to emphasize the need of frequent inspections to remove hazards and avoid service interruptions. Defective tools, unsafe ladders, drills and chisels with mushroomed heads and screw drivers with round or broken bits allowed to remain in the hands of workmen result in bad falls, injured eyes and gouged hands. Accidents resulting from defective tools and equipment are greatly decreased if standard tools and equipment are all inspected before they are issued and while in use and if tools in good condition are exchanged for defective ones upon request of the workman. Recently a workman fell from a pole as a result of a defective spur on a climber. This resulted in testing all of the climbers in the possession of workmen and in stock in that com-

A number of attractive Safety Bulletins, forcefully worded and graphically illutrated, are provided for its men by the Illinois Bell Telephone Co. of Chicago. While these were prepared more especially for its own employees, we feel sure that samples for adoption by other companies may be had by writing Mr. Bennett. All telephone men are deeply interested in such efforts to conserve life, limb and health.—The Editor.

pany and the manufacturer was required to test all climbers before shipment. Supplying goggles for men drilling rock or concrete and specially high grade rubber gloves for handling wire in proximity to foreign currents is a necessity although men should never be asked to handle wires exposed to foreign currents even in emergencies if there is any chance of having the power shut off.

Safe Working Methods and Training of Force.

The prescribed order and manner of doing the job—i. e. which operation should be done first—are elements of practice which require careful scrutiny to avoid injuries. For example, when replacing a pole in an existing lead the cross arms may be attached before the pole is raised but the additional hazard of the cross arms catching on wires or tree limbs more than offsets the extra muscular effort of placing the cross arm after the pole is in place.

Training the Force.—The usual point of attacking the problem of accident prevention is to remedy physical hazards and working methods. The most difficult and the most important factor in decreasing accidents is the training of those who receive injuries. The supervisor must be responsible for teaching safe habits of thought, (1) forethought, (2) caution, (3) equilibrium, (4) control, by means of (1) verbal instruction, (2) example, (3) impressing responsibility, (4) competition and (5) repeated printed instructions.

The individual workman, the last man in the organization, the man who supports it by his production, is the man who suffers the pain of an injury, whose mother or wife and kiddies are deprived of his earning capacity and he is sometimes forced to break up the home because we have not discharged our full duty in training him. Eighty percent or more of his injuries can be avoided if he is properly trained and uses proper forethought and caution. When we approach the problem of teaching him safe methods, we frequently try to catalogue the conditions resulting in accidents and issue a set of cautions—don't do this and don't do that—until the beginner begins to wonder which of the dozens of dozens of don'ts don't apply to what he is doing. Cautions on the job of course have their place but if we attempt to safeguard our workmen on this basis and have successfully told him all of the "don'ts" we know, and that we have ever heard, and that we can invent, the next day he may have an accident that you never heard a "don't" to fit. There should be some basic elements for teaching accident prevention which permit us to give positive instruction in such a simple manner that even a beginner may understand. Forethought, caution,—two fundamental habits of thought; equilibrium and control—two fundamental physical conditions—are the key words of accident prevention.

Cultivate Safe Habits of Thought and Action.

"Forethought", "watch your step", "look before you leap", are phrases that have become trite, and yet the lack of attention to them cause a large portion of our accidents. All of us can remember when we stepped on the end of a loose board and were surprised and injured when it came up to greet us. You all know of instances in dismantling plant in which poles have fallen with more or less disastrous results when the lineman cut the last wire, just because of failure to drive a bar into the butt of the pole to test it and take the necessary precaution of cutting loose at the next pole or guying the defective pole with handlines. Much of our inside work requires climbing on ladders or boxes or chairs. The substation installer usually borrows the nearest convenient means of support and proceeds with his work. The supports found around subscriber's premises are frequently poorly contrived and in unsafe condition. Forethought demands that all such supports be carefully inspected and tested before trusting them to his weight. The owner is usually glad to have a minor repair made to insure safety and we can better spare him a few minutes than to pay for a broken window, or to lose time or suffer pain. Forethought is the prophet preparing the way for caution. Caution is the teacher. It teaches the body to be prepared for the unexpected as well as for natural results. You have all read the story of "Haphazard Bill", the rapid workman who could do as much work as two of his fellows when he was not laid up by an accident. Of course, his boss likes to have him on the job because everyone speeded up trying to keep pace with him. But at the end of the year "Bill's" productive days balanced against the expense of caring for his accidents showed a loss. He encouraged his fellows to take a chance. "The chance taker is the accident maker".

Physical Safety—Hazards To Be Avoided.

As the mind governs the body so caution results in bodily equilibrium and control. Equilibrium may be rather a classy word for linemen but let's get the idea of keeping our balance. Men, ladders and poles will not stand alone if the center of mass or weight is not above their support. This is a physical fact known to everyone but its relation to accident prevention may never have been impressed on our minds before. Ladders seem to be the most common tempters to workmen to disregard this physical law. More workmen fall from ladders than from poles. Why? Because it takes time to climb down and reset a ladder and they will climb nearly to the top of the ladder and work as far as they can stretch in any direction. Finally their weight gets far enough away from the ladder to start it to slip, then a bruise, a sprain or a broken bone is the result. The base of all ladders is comparatively small and improper placing of a ladder makes it a hazard to the workman. These simple rules for placing ladders will save many accidents: 1. Place so that the weight is equally distributed on the legs of the ladder; 2 Place straight ladders so that the distance from the foot of the ladder to the supporting wall is not more than one fourth of the length of the ladder; 3. Place step ladders parallel to the line of the work, open as wide as possible with all four feet in good contact with the supporting surface. Ladders so placed are stable before any weight is placed upon them and if the workman does not defy mother nature by getting his weight into an unreasonable position, he is reasonably safe. Slipping and falling are other accidents resulting in most cases from lack of caution in keeping the body in a position so that the center of weight is between the feet. Let us take the example of a man pulling on a handline. If he places his feet together and pulls with all of his strength and his load gives way, he can not keep from falling. But if he uses one foot as a fulcrum and keeps the other under him, the load may give way but his back foot, is in place to catch him.

Always Be Careful of Your Wire.

Wire is our most used material and the lack of control of it has resulted in the loss of sight all too frequently. It has been cut while under strain and the ends suddenly released have

caused serious injury. How can a workman be sure that he is safe from such an injury? Assume that he is on a pole and cutting down a span with enough end to permit a splice, he can take hold of the short end with one hand and cut beyond it. He has control which will prevent the short end from snapping back in his face. Or assume that he is cutting wire on the ground, he can make a loop, holding both sides of the loop in one hand while he cuts the loop with the other. Does your workman drive a truck? It is needless to say that he must be able to control it at all times or he will add to the already too numerous list of casualties resulting from lack of control. Muscular control is equally important. Just a few days ago an installer was fastening a knob for drop wire under a slanting eave of a house. The wood was hard and no screw hole had been made so he climbed up so his head was above his work and braced himself against his heavy screw driver to drive home the screw. The screw driver slipped, struck the wood and then his eye. He explained later to his foreman how he lost control of his screw driver but this did not help the eye. Many repairmen have cut their hands while working on desk sets because they took some part of the instrument in the palm of their hands and tried to tighten a screw. The screw driver slipped, he lost control and the hand was cut.

Methods of Instruction—Suggestions For Foremen.

The foreman directs his men singly or in gangs by word of mouth. He is the school master who corrects their errors in methods and can correct their errors and can instruct them in an impressive friendly manner in a full understanding of safe methods. Too frequently, foremen wear their dignity and their coats and keep their hands clean. A foreman who is boss only, makes a poor showing compared to one who recognizes that one of the largest elements of his success is his ability to teach by example by working with his men enough to show the correct and safe way of doing the job. The executive must recognize that he is responsible for accident prevention in the same way as he is for quantity of production and economic use of time and material. The responsibility of the foreman for his gang is just the same as the executive for the whole operation. Training foremen and workmen to accept their responsibility is comparatively simple in a small organization where the contact with the entire working force is direct and personal. In larger organizations this contact becomes more remote and more difficult. A successful plan for impressing responsibility is in effect in the Illinois Bell Telephone Co., which was adapted from a similar plan used by the Ohio Bell Telephone Co. A large chart was made which bears along the left hand margin the name of each district or group supervisor. Across the remainder of the chart are columns for each month of the year. After each supervisor's name a solid line is drawn at the end of each month in which his forces have no lost time accidents but if there is a lost time accident the line is broken and the name of the foreman, the number of accidents and the days lost are entered. The workman's name does not appear but the foreman whose name appears on the broken line does not fail to impress the responsibility upon the mind of the workman who caused it.

Competition—A Spirit of Emulation Desirable.

For the development of interest in accident prevention the spirit of competition is next in importance. The chart just mentioned embodies this element as well as impressing responsibility. It is pleasing to note the interest of supervisors and foremen in keeping their line on the chart unbroken. A "no accident" trophy with a suitable inscription awarded to the group with the fewest accidents for a period promotes the team spirit and helps to develop safety habits.

Printed Illustrations and Analysis of Accidents.

The National Safety Council has a service which consists of striking posters which are frequently changed. The safety supervisors of large companies have developed similar bulletins that are more applicable to the telephone business and probably can be readily obtained by the smaller units. The Illinois Bell Telephone Co. issues posters monthly for safety bulletin boards located in prominent places where men congregate. Employees of this organization are paid by checks mailed to their homes and once a month a neat blotter with a calendar and some striking slogan or caution about accident prevention is included in the pay envelope. Installers and repairmen are furnished with memorandum books and the books furnished have a safety slogan printed on the covers.

Analysis of Accidents—In the maintenance department of the Illinois Bell Telephone Co. every personal injury whether resulting in lost time or not is analyzed. The injuries are reported on a special form to which is attached a statement signed by the foreman to the effect that the cause of the accident has been discussed with the workman and that the foreman and workman have agreed as to the cause and the prevention of similar injuries in the future. The accidents are further analyzed by the department heads and are divided into unavoidable and avoidable. Most of the injuries are due to lack of forethought or caution of the injured. Accidents due to lack of forethought or caution of others than the injured are divided between fellow workmen and outsiders. It is a simple matter to get to the fellow workmen and see that they are instructed. Defective sight has resulted in repeated accidents and occasionally the workman himself does not realize the cause. Glasses effectively remedy such cases. Injuries due to defective tools always cause an investigation to determine the quality of tool furnished. A study of the adaptability of the tool to the job sometimes results in a change of type or in general tests of those in use or in stock.

Minimizing Effect of Injuries—First Aid.

Our second major objective is the minimizing of the effect of such injuries as occur. One of the ways is by first aid. First aid in many minor injuries can be applied by the injured if he has the equipment. Prompt attention to cleansing and disinfectiog cuts or scratches frequently avoids infection and sometimes death by blood-poisoning. The old idea of using a chew of tobacco or other less cleanly application may still be in the minds of many men unless some positive means of guarding against infection is supplied. A small packet containing compresses and iodine can be furnished each workman at a nominal expense. Variations of this packet may be made to fit the work, such as a phial of aromatic spirits of ammonia where an inhalent may be needed to assist in resuscitation from exposure to gas, or a tube of vaseline or suitable ointment to apply to burns. Larger first aid kits may be supplied for gang and office use. Competitive first aid teams have been organized by some companies to stimulate interest in accident prevention and to provide knowledge of the treatment of accidents to minimize their effects.

There is in nearly every city of any size a boy scout troop. First aid is one of the important features of boy scout training and it is a simple process to get the local scout master to have his troop give assistance in this training. In the larger cities the Red Cross has expert instructors who can be secured to instruct a class of employees in first aid and they in turn can form classes of their fellows.

Importance of Prompt and Proper Medical Care.

Medical care is necessary to follow first aid in the more serious injuries. As the telephone is a necessity to every doctor, it is not difficult to establish relations with some competent physician in every community to care for the injured workmen. At this point friendly interest of the foreman plays an important part. It is easy to turn our injured fellow workman over to the doctor and have his case off our hands but the foreman who realizes his responsibility for the comfort and well being of his workmen has his opportunity to take a friendly, constructive interest in the care and by seeing that the doctor and the family understand that he is keenly interested, the attention may be better and certainly the workman can be made to realize that the company is his friend at a time when friendship is needed. The foreman can also ask fellow workmen to help him to see that their unfortunate fellow has frequent visits to keep him cheerful.

Alternate Work—The injured employee who does manual labor requiring muscular strain usually passes through a tiresome convalescent period. It is difficult for any experienced supervisor in this business to conceive of such ideal conditions about an exchange that there are not many light tasks which have been hanging on until someone could get to do them. The tiresome convalescent period of the employee can be filled in doing these jobs. It is probable that the employee will not earn his pay at this work but why not get the economic and educational advantage of assigning him tasks which do not cause pain or retard recovery. We always desire to have men who can relieve on some other job. This is the opportunity to train men who can relieve in the office. The employee who is interested in his work welcomes the opportunity to familiarize himself with other details of the work. It helps him to perform his regular work more intelligently, makes his job more secure and makes his value greater. Assuming that the injured employee is of a different disposition and considers his injury in the light of a prolonged holiday hoping to make it as long as possible, we can have him under closer observation and can better judge when we may expect him to return to full production.

The writer makes no claim to authorship for the arguments herein set forth. This is a summary of experiences and conclusions as one of a group of Department Heads gathered in weekly conference on accident prevention over a period of more than six years. A National Safety Council bulletin has well stated: "This is what safety work, Being Careful, means: That the workman shall live to enjoy the fruits of his labor; that his mother shall have the comfort of his arm in her age; that his wife shall not be, untimely, a widow; that his children shall have a father, and that cripples and helpless wrecks who were once strong men no longer shall be a by-product of industry."

DEPRECIATION.

Like the poor, depreciation is always with us. Recently the interest in it has centered about the questionnaire of the Interstate Commerce Commission.

It is a fad with some speakers on the subject to preface their remarks with the statement that they know nothing about depreciation.

Some of them don't.

If some of those who do would give us as close reasoning on the practical side as they do on the theoretical, we might get somewhere.

We know one manager who does not theorize. He knows depreciation when he sees it, cares for it as it takes place and provides a reserve for that which will take place in the future.

Perhaps all managers will be like him some day.

Perhaps they wont.

When Our Sleet Troubles Are Over

—Photo Fotograms.

Jack Frost has done a nifty job of decorating these telephone poles up in Alaska. Though the scenic effect is unique Alaskan linemen are said to have no eye for this kind of art. However, they'll load their pipes with a fistful of fine cut, hitch the huskies to repair sleds and hike right onto the job. Men go forth into the long, long nights, look death straight in the eye with a grin on their half frozen faces. The spirit of public service blazes as warmly in the Arctic wastes as in the tropics.

Your Right in Making Rates

A Notable Address on the Telephone Company's Right to Make Its Own Rates—A Common Sense Statement of the Law That Removes Many Vital Misconceptions

By Nathaniel T. Guernsey

(Vice President American Telephone and Telegraph Company)

I propose to present to you three propositions as to the general effect of the utility laws in this country. These propositions are, (1) that these laws do not take away from the utilities the primary right to make rates, (2) that these laws do not impose any new limitation upon the amount which a utility may earn, and (3) that under these laws reasonable rates may be, and generally should be, rates which yield more than a bare fair return upon the value of the property devoted to the public use. I know that four men out of five whether they are connected with utilities or not, especially if they are confronted with adverse conditions, are disposed to complain of these laws and to say that they have taken away the company's right to make rates, that they have limited the amount that the company may earn, and that the maximum rate which can be charged under them is one that barely escapes the confiscation rule. This common belief is directly opposed to the propositions which I have just stated. I believe it to be wrong and believe my propositions to be right. In discussing them, my hope is that I may suggest to you something that it is worth your while to think about and that perhaps I may convince some of you of the soundness of my conclusions. The trouble has been not with these laws but in their administration, and this trouble in their administration is, in my opinion, largely attributable to the fact that the utilities have themselves failed to interpret these laws correctly, and have failed to urge this interpretation upon the commissions and the courts.

Utilities Make Their Own Rates.

Re-stating my first proposition, it is not true that the commission laws have taken away from the utilities the primary right to make rates. Your own situation here in Illinois is fairly typical of the general situation. Prior to the enactment of your utility laws the Chicago Telephone Company, as it was then—the Illinois Bell Telephone Company as it is now—was understood to have plenary rate-making powers. It then had the power to make its own rates, subject only to the restriction established by the common law that its rates should be just and reasonable and not unjustly discriminatory; that is, while the company fixed its own rates, in fixing them it was bound to conform to this rule that they be just and reasonable and free from unjust discrimination. While this rule had never been put into the form of a statute it was, nevertheless, the law and bound the company just as effectively as if it had been enacted into a statute by the legislature.

The next step in the argument here is an easy one. This right as to rate making which the company had prior to the enactment of the commission laws in Illinois continued in the company unless these laws took it away. It is self-evident that if this right existed it would continue unless taken away.

Rates Must Be Just.

The next step, I think, suggests itself from what has preceded. It is that, instead of complaining about the law, instead of assuming that it has done something that it ought not to do, we should look at the law and see whether or not and to what extent it has changed or restricted this right to make rates, which existed before the law was passed. Looking at the law for this purpose, you will find that it does not change the old common law rule, that rates shall be just and reasonable and not unjustly discriminatory, but that all that it does in this connection is to reestablish this rule, as the rule to govern the company's rate-making, re-stating in the statute what has always been the rule at common law. In doing this the statute is what we call technically merely declaratory of the common law.

The situation, then, is this: Prior to the enactment of this statute the company's power to make rates was subject to the rule that the rates made by it should be just and reasonable and not discriminatory. The enactment of this statute did not change this situation. The statute declared that the company in making its rates should be governed by the same rule which had always governed it. In this connection all that the statute did was to continue the old rule in effect.

The law, then, having declared that the old common law rule shall continue to be the rule pursuant to which rates shall be made, under this law the primary rate-making power and rate-making duty is left in the company, just where it has always been. I do not believe that there can be found in it one word that looks toward taking that right away. The law contemplates that all rates in the first instance shall be made by the company and, so long as its rates conform to the rule that they shall be just and reasonable and not unjustly discriminatory, leaves the entire rate-making power with the company.

What, then, is the rate-making power which the law confers upon the commission? The only rate-making power of the commission is this: If it appears that the company has established rates or has continued in effect rates which are in violation of the rule that all rates must be just and reasonable and not unjustly discriminatory—in other words, if it appears that the company's rates are a direct violation of the rule which was the law before anybody in this room was born, and is now the law, then, but not until then, the power of the commission to establish rates arises.

The law does not contemplate that the commission may determine arbitrarily that rates established by the company are unlawful because outside

of the rule referred to and so vest itself with jurisdiction to fix rates. On the contrary, before the jurisdiction of the commission arises it must be shown that the company's rates are unlawful and this must be made to appear at a hearing, of which the company is entitled to notice and at which it is entitled to be represented and to introduce the proof to show that its rates are lawful and proper. When it is shown, as the result of the evidence introduced upon such a hearing, that the company's rates are unlawful because not in conformity with the rule that they shall be just and reasonable and not unjustly discriminatory, and not until then, the power of the commission to substitute other rates for them arises; and the commission in the exercise of this power after it has arisen is subject to the same rule which binds the company. The only rates which it is authorized to establish are rates which are within this rule and are just and reasonable and not unjustly discriminatory.

Summarizing, the situation under the Illinois commission law, and this is fairly typical of the situation throughout the United States, is this: The primary right of rate making is left in the company, subject only to the rule that its rates shall be just and reasonable and not unjustly discriminatory—the same rule which governed the company's rate making prior to the enactment law. The commission is only authorized to make rates in those cases where, after a hearing, it appears that the company has violated this rule and that its rates are therefore unlawful. Under those circumstances the commission is authorized to substitute for the unlawful rates of the company lawful rates established by the commission.

Commission Does Not Manage.

The effect of this law I sometimes illustrate by comparing the regulatory body with a policeman, who is a regulator with whom we are all familiar. A policeman's duty is to see that The law is obeyed and through enforcing obedience he enforces protection to my property and rights. He does not come around before I get up in the morning and tell me when to get up, what to wear, what to eat for breakfast, when to go to the office, when to have my luncheon, when to leave the office, what to do after I leave there, and when to go to bed. He does not direct my actions for the day, or any part of it. He walks his beat and observes and as long as I stay within the law I am free to do exactly as I please without any interference upon his part with my actions. But if I overstep the line which the law draws he, with more or less force and emphasis, puts me back. This, I think, fairly illustrates the true function of the commission under these laws. These laws do not contemplate that the commissions shall direct the transaction of our affairs, either as to rate making or as to anything else. Certain general rules are established which is not new but old. So long as the company obeys these rules and keeps within them its freedom to act is retained. It is only when the company oversteps the rule, when it breaks the law, that it is contemplated that the commission shall intervene so as to put it back within the rule.

This provision in these laws authorizing the commissions to come in and establish rates that conform to the law when it is found that the company's rates are unlawful is a reasonable and proper provision which is necessary to proper regulation and against which no just complaint can be directed. Rather, I believe, are the lawyers who have permitted the misconception of these laws to stand uncorrected subject to criticism for their failture to emphatically assert their true interpretation.

Laws Don't Limit Earnings.

Passing now to the next question, these laws do not impose any new limitations upon the amount which utilities may earn. The impression is generally prevalent—I must plead guilty with the rest; I formerly had it myself—that the utility laws limit the amount which the company may earn. I am entirely convinced that this is a misconception and that these laws are not susceptible to this construction. If the law imposes any limitation upon the right of the company to earn, this limitation must appear in some limitation upon the rates which the company may charge, because if you will let me control the rates I can control the earnings. The rates make the earnings. We have seen that prior to the enactment of these laws the only limitation upon the rate-making power of the company was that its rates should be just and reasonable and not unjustly discriminatory. The company had the right to earn all that it could charging just and reasonable rates. These laws have left this situation absolutely unchanged. They have re-enacted this same limitation upon rates; they require the company to charge just and reasonable rates. They impose no limitation upon what the company may earn, charging such rates. If the popular conception that these laws limit the right of the company to earn is sound, then there must be something in the laws—some language in the laws — that will justify this. I have not been able to find any such language and I do not believe that anyone else can find it, because I do not believe that it is there.

These laws do not in terms deal with earnings. They do not in terms attempt to measure or to control earnings. What they do deal with is rates. What they attempt to measure is rates. Their rule and their only rule as to rates is that they shall be just and reasonable and not unjustly discriminatory. They leave the company just exactly where it stood before the laws were enacted, with the obligation to charge rates which are just and reasonable and with the right to earn whatever it can charging such rates.

This is an extremely important proposition. The misconception with reference to it has been tremendous. That misconception is prevalent all over the United States. It has resulted in other misconceptions, collateral to it. It is, I believe, at the foundation of almost all that there is in the way of mistaken administration of these commission laws.

What I say to lawyers when I am discussing this matter and what you may say to them is this: The company had the right to make rates and it had the right to earn all that it could under just and reasonable rates prior to the enactment of these laws. What has become of these rights? We have seen that these laws do not purport to take them away, but on the contrary assume that they continue. But if they could be taken away this could only be done through some legislative enactment. These rights could not simply disappear. They could not shrivel up or dry up or blow away; so that I say to those who doubt: Take this law and point out the specific language in it which can be construed as supporting your contention. If the law makes such a limitation the language doing this can be found in the law. The language is not there. The law does not make the limitation. The right of these companies under these laws is exactly what it was before these laws, namely, to earn whatever they can under just and reasonable rates.

Utility Must Make Money.

What is good law is usually good sense and that is true in this instance. Sound economic rules demand that the rates be just and reasonable and that the company be permitted to earn

what it can under such rates; consequently, instead of apologizing for making money the right point of view would impose upon the company an obligation to explain if it were not making money; because to enable the company to give efficient and economic service it must be making money. It ought to be and is to our discredit if the company is not making money.

What I have been saying suggests an incident which occurred one day in Atlanta. One of our people there said to me, "The other day I was talking with the mayor of Jacksonville and he said we ought to be able to obtain our money for two or three per cent. Now what would you say to a man like that?" I replied, "I would have told him that we thought so too, but that the man who has the money will not do it." In other words, I would have taken that opportunity to make the mayor of Jacksonville see that neither the commissions nor the company can fix the rate which we must pay for the money, but that this is inevitably done by the man who has the money.

All the officials and, I am sure, many others of you know that the company cannot make additions to its plant without paying for them and that this takes money. This takes a lot of money for the Bell System—it takes a lot of money for the city of Chicago—and when it comes to raising that money you must go for it to the person who has it to invest and induce him to part with it you must offer him some securities that will afford him an opportunity to make some money. It is necessary to present to him facts that will make him see that he will be better off if he takes the securities and gives up his money than if he refused the securities and kept the money. That is what selling anything means. Grocers could not sell groceries if they could not convince the man who is buying that they have what he needs and that by buying he will obtain something worth more to him than the money that he pays for it. Telephone service could not be sold today if it were not made clear to the subscribers that the company has just what they need. If the man who gives us five dollars for service is better off with the service than with the money, then he will buy the service and we can sell it. It is this benefit to him that induces him to give up his money. That is the only basis upon which our business can be built and this is true of every business, whether it be telephones, ships, merchandising, banking or anything else.

Returning to my point from this digression, you plainly see that if you and other investors are to go into our business by becoming owners of our stocks and bonds it must be because you have the right to make something out of it. You may be philanthropists in other things but when it comes to investing your money you are not and ought not to be philanthropists. The business must earn you money upon the money which you invest in it. There is no reason in the world why if people want telephone service they should not pay a fair rate for it, any more than that they should not pay a fair price for groceries, so that from an economic point of view this business could not continue if we had not the right to earn a profit and if money invested in our business had not the same right to a profit as money invested in other enterprises, taking into account the character of the business and the hazards.

Laws Cannot Fix Rates of Return.

Laws are powerful things, but there are some things that are beyond their control. They cannot fix what shall be a fair return; they cannot determine what return will induce us to invest our money. If the law attempted this and said that 2 per cent should be a fair return, this would not make it a fair return. Nobody would take it; everybody would refuse to invest.

An act of the legislature has as much sanction, as much force, as an order of a city council or of a commission. None of them can fix the rate for return. If they could and a return fixed by them would produce the money, obviously it would be to the interest of the company to make it as low as possible. The ideal situation for the company would be one where it could obtain the money for nothing, but no legislative act can do this. Economic laws are stronger than any statute that violates them. They would bring about the nullification of any statute which attempted to compel any business to accept less than the profit to which it is normally entitled.

My third proposition was that under these laws reasonable rates may be, and generally should be, rates which yield more than a bare fair return upon the value of the property devoted to the public use. The fact that the rule established by the law as to the company's rates is that they shall be just and reasonable immediately suggests the inquiry, what are just and reasonable rates? Upon this question there has been much misconception. Upon one point involved here the law is thoroughly settled by the decision of the courts. If 8 per cent be a fair return this does not mean that 8 per cent is the limit of what the company may earn under just and reasonable rates. The fair return does not measure the maximum of what a just and reasonable rate may produce. On the contrary, just and reasonable rates should normally earn more than a bare fair return. If 8 per cent were a fair return and the company were actually earning 10 per cent the excess over 8 per cent would not be a fact that of itself would authorize a commission or a court to say that the rates were exorbitant—that they were unjust and unreasonable.

What Is a Reasonable Rate?

To the question, what is a reasonable rate, there has been devoted too much arithmetic and too little common sense. Many people have the idea that the way to ascertain what is a reasonable rate is to compute the cost of doing the business, including the fair return, and then to establish rates that will realize exactly this amount.

Nobody would invest in any business upon such a basis. Suppose it were a question of starting a bank, a grocery store or a store such as Marshall Field's or Tobey's in Chicago, and suppose that you were to say to the man or group of men considering going into the business, "We will put our prices on a basis that will guarantee that you will not make more than 6 per cent or 8 per cent on your investment but we will not guarantee that you will not lose some money." How much money do you think the group would invest? Your own common sense would condemn any such proposition.

Just as soon as people will do in connection with the telephone business what they very frequently do not do, that is, forget all of these fine-spun theories and treat it as involving normal business transactions, troubles will begin to disappear. The company has some service here which it desires to sell. What is a reasonable price for it? The factors which fix the reasonable price are these; on the one side there is the cost of rendering the service. The company cannot undertake to sell the service for less than it costs to render it, the cost including the fair return. If it did the re-

sult would be what is always the result when an attempt is made to do business at a loss. If it is persisted in, bankruptcy follows. On the other hand there is the value of the service to the man who buys it. Just as service cannot be produced for less than its cost, which includes the fair return, so it cannot be sold for more than its value to the subscriber. Usually it must be sold for less than this value.

This brings us to considerations that are very simple and at the same time fundamental. It is a safely accurate statement to say that all business is founded upon the proposition that in general sound trades must benefit both parties to them. This is true of every kind of business.

What makes the telephone business possible is the margin between the cost of rendering the service, including the fair return upon the money, and the value of the service to the persons who use it. This margin measures what the telephone art and science laws have contributed to the welfare of the community. It is a tremendously large item. If you wish to know just how large it is ask someone whose telephone service has been interrupted or who is waiting for the installation of a telephone. His estimate of the value of the service will be immensely greater than what he has to pay for it.

What has been said is the basis for the sound definition of a reasonable rate. It is a rate that equitably divides this spread between the cost of the service, including the fair return, and the value of the service to the subscriber. Where the line shall be drawn in making this division will vary under varying conditions. I think the tendency should be toward a line which would give to the company out of this spread, in addition to a fair return, compensation for efficient management, for improvements in apparatus and methods, and for good service, leaving by far the larger part of the spread as a profit to the subscriber. It will never be possible to draw this line exactly in accordance with any arithmetical or mathematical rule. In general, where the rates are low and the spread is small the profit to both the subscriber and the utility will be less than where the rate are higher and the spread is larger.

An Experience in Ohio.

One of the questions which is going to be presented is how to arrive at the value of the service. In this connection, what took place in a town in Ohio, where dual telephone systems had been operated for many years is interesting.

Efforts were made to merge these properties into one system and a local grocer, who opposed the unification of service, circulated a petition among the business men in his neighborhood urging them to oppose the merger, his argument being that after the unification of service he would still require two telephones at higher rates in order to properly serve his patrons, and that the consolidation would mean an additional expense to him of $2.50 per month. However, the telephone subscribers were generally favorable to the merger and the service was later unified. Some time thereafter the service was suspended. The town having no street car service, grocers placed a great deal of dependence upon telephone service to attract trade from outlying sections of the town. With the assistance of the telephone, this grocer had been able to time his orders, employing one solicitor and one driver to perform all of the work. When the service was suspended, he was not only put to the expense of an extra solicitor, but found it necessary to make deliveries at irregular times throughout the day, which required the services of an additional driver. It is quite clear, therefore, that the loss of telephone service cost this grocer the wages of two extra workers, a sum greatly in excess of the cost of his telephone service.

Later, after the resumption of service, the rates were increased, with the approval of the subscribers. At that time this grocer stated to the company's manager that he had never before realized what his telephone service was worth to him and that the company need have no fear of any objection on his part to any increase which might be found necessary. This indicates concretely how progress may be made toward valuing the service by using the value which the subscribers themselves put upon it. If it is ever necessary to do so, I think that we can demonstrate that the value of the service is so greatly in excess of what is paid for it as to make the profits to the subscribers so large that any profits which the companies might anticipate would be in comparison absolutely insignificant.

I have covered the three points which I am attempting to make. It is a mistake to say that the company has not the right to make rates. We may confidently assert that we have substantially the same right there that we had before the enactment of the commission laws and that the rate-making power of the commissions is limited, like the policeman's power, to bringing us back when we violate the law. Again, these laws do not limit what the company may earn. It is a mistake to talk about what the company is allowed to earn. It is allowed to earn all that efficient management will produce under just and reasonable rates, just as it was before these laws were enacted. Finally, a just and reasonable rate is not one limited to earning a bare fair return. It is one that equitably divides the spread between the cost of rendering the service, including the fair return, and the value of the service, so that both the company and its subscribers may profit by the transaction of the business.

One of the radical fundamental errors to which may be attributed many of the troubles incident to regulation has been the assumption that the duty imposed upon the commission is to regulate profits. This is not their duty. Their duty is to regulate rates to the extent of seeing that the rates made by the companies are just and reasonable, so as to conform to what was the old common law rule and is now the statutory rule. If the rates are just and reasonable that is the end of the matter.

Phoney Tale Adds Wisdom and Subtracts Cash.

Washington, D. C. — Senator Spencer of Missouri paid $65 for a demonstration of a new stunt in telephone swindling. The senator received a long distance telephone message ostensibly from Frank O. Watts, president of the First National Bank of St. Louis, stating that his son, Lawson M. Watts, had been robbed on a train bound for Washington and asking the senator to supply him with funds. The senator went to the railway station and had a notice displayed on the train bulletin board instructing Lawson M. Watts on arrival to come to the senate office building. An hour later a young man appeared and so introduced himself. The young man thought $50 would be sufficient as he was on his way home. Senator Spencer pressed an additional $15 upon him. After the young man had departed the senator telephoned the bank president. "Must be some mistake," said Mr. Watts, Sr., "I did not telephone you and my son is sitting by my side."

WHAT IS YOUR TROUBLE?

A Department of Questions and Answers

Our new department "What is Your Trouble" seems to have "caught on," as numerous inquiries received would indicate. We had a feeling that a service could be rendered, and our readers seem to be taking advantage of the opportunity to present some of their problems. This month we have a number of questions from the radio field, showing the increasing interest that is being taken by operating telephone companies. Most of the present list deal with questions of policy in connection with the entrance of telephone companies into that field. We are glad to answer questions of this type, as well as those of technical or engineering nature. Let us help you with your difficulties. Also remember the invitation to contribute your answer, if you have a better one than we give. W. N. Furthmann has come to our assistance in answering the following questions:

1. How many receiving sets of radio apparatus were sold last year; also, thus far, this year?

Ans. There were 50,000 sets sold last year and 650,000 sets sold so far this year. These figures are quoted by the Secretary of Commerce at Washington.

2. What has been the principal reason for this sudden boom in sale of radio apparatus?

Ans. The principal cause has been the establishment of broadcasting stations in large cities. Telephone companies are becoming interested in the establishment of stations in the cities and town where they operate. The Bell System is planning to establish several such stations in different parts of the United States.

3. Will the standard charters of telephone companies permit them to undertake the maintenance of a wireless broadcasting station?

Ans. The charters of telephone companies are usually broad enough to permit such operation. Care should be exercised that the material sent out be news items, music and entertainment. Purely advertising is not likely to be permitted. The Bell system proposes only to furnish the service; not to furnish the news items or other information, music, etc. that may be sent forth. It would be a good plan to be guided accordingly.

4. Would telephone companies be considered proper agents for the sale of radio apparatus to their subscribers?

Ans. Radio manufacturers are already forced by a proper sales policy to limit the distribution sale of their apparatus. A number of manufacturers would undoubtedly prefer to sell to telephone companies exclusively in the companies' respective territories.

5. Will you please advise if it would be good practice to distribute broadcasting news and entertainment by wire to subscribers in general?

Ans. There is no good, practical reason why such service could not be rendered. A separate panel or board section might be set aside for this service. A subscriber asking for such service, would simply be connected to this distributing panel or board and the proper service obtained. A simple rule could be provided that such service is to be secondary to all other service, incoming calls having complete right of way. Logically, a subscriber would sanction the cutting in of any business or personal call in preference to broadcasting service. On party lines, service for broadcasting would be limited in extent, specified intervals of not more than 5 minutes being permitted for this service. Simiiar service rules have been established in large cities by telephone companies distributing baseball, election and other news. Therefore, it can be said this method of handling the distribution of broadcasting radio news would in no way be new or experimental.

6. Do you know of any patent litigation that would be liable to cause difficulties in the purchase and use of either sending or receiving radio sets?

Ans. The Armstrong patents on regeneration circuits and the De Forest patents on amplifier tubes are the principal items to be assured about, either in the purchase or the use of radio sets. Both of these patents are well understood as fundamental in the art and have had the necessary court procedure to make them stable and protective. Any reputable manufacture always will be willing to furnish proper guarantees against patent damages or litigation, so be certain to deal with reliable firms and to request both of these assurances.

7. What is the status of delivery by reliable manufacturers?

Ans. There are several factories which are able to deliver within from six to eight weeks from date of order. Some are able to deliver in three months, and still others only within six months. Many of the factories are working twenty-four hours a day and, since the first of the year, have doubled and trebled their capacities. This means you should decide to get your orders in promptly and, also, illustrates the sudden and enormous demand for this apparatus.

8. Please give the ranging list of prices for receiving sets; also the trade discounts?

Ans. Receiving sets range in price from $25 to $250. The maximum discount for $1000 worth of equipment is 40 per cent.

9. What service, in addition to news items, weather reports and entertainment, is being developed?

Ans. The Board of Trade is broadcasting market quotations in Chicago every half hour, beginning at 9:00 a. m. This information is particularly attractive, not only to certain lines of business but to the farmer as well. Another desirable field is the newspaper. The publisher is finding a reliable and economical means of sending messages at night to its agents. The saving to a newspaper in this respect is great. Telephone companies are particularly reliable agents for the distribution of such information and, if they do not step in to gather this harvest, outsiders may enter the field and reap the profits.

10. Is broadcasting considered good, reliable advertising?

Ans. The opinion of the authorities and of the Washington Conference was decidedly against the use of broadcasting for any form of direct advertising.

11. When was "wireless telephony" discovered?

Ans. The De Forest system was one of the pioneers in the development of wireless telephony. He started his experiments on the Transportation building in Chicago, in the year 1902.

13. Do atmospheric conditions limit the sending of radio messages?

Ans. Electrical conditions of the weather materially affect the extent of sending and receiving radio messages. A radius of 150 miles, however, would be a guaranteed area of distribution.

14. Are the De Forest "honey comb" coils and the circuit thereof considered any infringement of the Armstrong patent or regenerative circuits?

Ans. The two systems are not considered infringements of each other.

15. In your opinion, are wave filters considered essential for good wireless transmission?

Ans. As far as the writer is aware, so called wave filters are used in all wireless systems. The principle of a wave filter involves inductance and capacity. Any wireless set is essentially composed of both. Since both of these measurements have been used in calibrating instruments in electrical laboratories for many years. It is difficult to conceive of any wireless patent that would prevent the operation of a sending or receiving set, thus equipped.

16. In what way are telephone companies especially equipped to maintain and operate wireless systems?

Ans. In the first place, they have at hand a reliable source of power; secondly, they also possess the trained employers so necessary in a highly complicated system of transmission not only for operating but also for maintaining and protecting it and the surrounding properties.

NO MOONSHINE HERE.

Straight Stuff Comes From This Still in Texas—Read His Remarks.

In his address to the seventeenth annual convention of the Texas Independent Telephone Ass'n, Pres. R. B. Still said, among other things: "The United States Census of Electrical Industries credits the Independent Telephone companies of Texas with operating 53.4 per cent of the whole number of subscribers telephones in this state, Texas being one of sixteen in the United States in which the Bell telephones are outnumbered by the Independents. From the same census we find that there were 21,175 public exchanges of which 14,887 with 4,389,660 subscribers belonged to Independent companies and 6,288 exchanges with 7,326,858 subscribers owned by the Bell Telephone Co. The total investment in plants, including toll lines, was $1,492,329,015.00, or an average of $127.00 per subscriber. The last census report of our industry on page 32, refers to the number of Bell owned and non-Bell, but connecting companies, as Bell 7,326,858; Independent 3,164,902, and continues with these remarks:

"Although the 3,164,902 connected telephones were neither Bell owned nor Bell controlled, they should be reckoned as a part of the Bell system when considering the scope of the service afforded by the American Tel. & Tel. Co." Just why should we be "reckoned" as a part of the Bell system? Why not reverse this and say that because of the scope of the service when Bell lines are connectible with ours, their entire 10,490,760 telephones should be considered as Independents? I surmise that such remarks in the report are "inspired," and that such "inspiration" is made possible by the Bell company's organization and alertness.

Bell Alleged To Treat Connecting Companies Unfairly.

I recommend that this convention appoint a committee composed of your president, secretary and three other members representing companies owning toll lines that connect with Bell lines and interchange toll service on the pro-rated plan of division of rates, based on "air-line" mileage. This committee is to investigate and report its findings and recommendations to the membership at a future call meeting, after determining if it is impractical from a standpoint of accounting and reporting, to continue settlements with the Bell company upon the present basis. Under the present system it is impossible for a company owning lines for which the Bell acts as agent to get from the Bell reports that can be checked as to accuracy. The rights of our people to demand of them dependable and understandable reports of the business handled by us is entirely ignored or forgotten. We are required to make various reports to them, but when we ask for similar ones, we are politely informed that under their system of accounting and reporting it is impossible—so there we are.

What the Independents Need Most.

As I consider the small Independent telephone systems in our State, their interests may be protected, and a more co-ordinated plan of dealing with one another and the public served, by two things: (a) better construction and maintenance; (b) a comprehensive system of accounting. It is my dream that, within a reasonable time, we will so complete our organization as to have a consulting engineer under direction of a Plant Committee whose services will be at the command of our members at a cost they can afford, and use him freely in their planning and general maintenance work. Those who feel the gradual "closing in" of the Interstate Commerce Commission; the call each year for just a little further information, a few extra reports and a few thousand more figures, have come to the realization that we had just as well fall in line. Seeing results in the way of showing yourselves what your business is doing, you'll finally conclude that maybe no more is demanded than should be. Our lack of information proved to us that we have not of our own accord kept strict enough record of our business to prove just what we are doing; what we have earned, what we have lost, or what a fair rate of depreciation has been. In other words, we have either "guessed off" our depreciation or have not considered it at all. The Commission is attending to the larger companies first, hence the class "D" companies have so far escaped but your time is coming. You should go home from this convention with the full determination to adopt a simplified system of accounting which will meet the requirements of the Interstate Commerce Commission. My advice to the small companies is that your own time is too badly needed on other duties to justify you in attempting to keep a "general accounting system". Your interests can be served best by having some competent telephone accountant do this work for you at a reasonable monthly cost. Along with this accounting, your income and other tax reports can be carefully made and filed. In this way you may get the same efficient service as the larger companies.

Newsy Advertisement Tells Bell Plea for Increase at Peoria.

Peoria, Ill.—Carrying a regulation newspaper head, but appearing over the signature of the Illinois Bell Telephone Co., a convincing and newsy summary of the Bell case for increased rates recently appeared in local newspapers. The appearance of the advertisement and the calm, logical copy made the publicity an effective piece of right rate propaganda.

Type A 27 Pole Cable Terminal

Type A 27

FITS POLE
NO GAINING

Will Give Relief
From Fuse Contact
and Carbon Troubles

Phosphor Bronze Fuse Clips
That Bite Through Corrosion
to the Clean Metal

EMPLOYS NO. 27 STANDARD FUSE—CUT IS FULL SIZE

HOT GALVANIZED COVER—LASTS LONGER

The Cover is made from Black Sheet and then dipped in Molten Zinc, which gives a Continuous Unbroken Zinc Coating.

LOTS OF ROOM TO DRIVE LAGS

Equipped with P495 Sawtooth Discharge Blocks.

Reliable Electric Company 3145 Carroll Ave., Chicago, U. S. A.

Harding's Radio to Have Cords From Runzel-Lenz.

Chicago, Ill.—Runzel-Lenz radio cords have been ordered by long distance telephone from Washington, for use in President Harding's personal radio set. Mayo Lenz says it's now certain that the president will get his information straight.

Makes Tree Trimming Easier With Rope Pull Device.

Detroit, Mich.—A tree trimmer that is being widely used with success in the telephone industry is being made by the Bartlett Mfg. Co., 428 E. LaFayette Ave., Detroit. A rope pull operates a handle lever which increases the power of the cutting blade. An insulated handle also is an interesting feature of the trimmer. Sections are furnished with this Bartlett device, which allow lengthening the trimmer to 16 feet. The makers claim this trimmer is unequalled for its easy operation, safety and convenience.

DID YOU KNOW THIS?

Rope from ships that have sailed the Seven Seas—rope that has tied to every port in the world, ends its career by guarding a nation's telephone conversation.

From junk rope is made the high grade of paper which insulates each wire in a piece of telephone cable. Over 13,000,000 pounds of old rope are fed to the giant vats which tear, cook, wash and beat into a pulp the makings of 7,000,000 pounds of cable paper—the Bell System's yearly requirements.

Sea-worn rope, old rope, of every description, is but one of the thousands of raw materials that come from across the street and from the far corners of the world to meet in a telephone system.

All this was news to us. Is it to you?

—Mountain States Monitor

English Have No Sense of Humor? Bally Rot!

New York City.—Immigration inspectors have allowed admittance to the jest about the Cockney who wanted to put through a call for a number in the Erling exchange. This recent important says the anxious party made his case plain to the operator by saying, "E for 'Enry. A wot 'orses eat, L where yer goes to, I wort ye see wiv, N as lays an egg, and G whiz."

A. E. F. Vet New Bell Boss At Harrisburg, Pa.

Harrisburg, Pa.—Henry W. Taylor, in the employ of the Bell Telephone Co. since 1912, with the exception of time spent with the 406th Telegraph Battalion, has been made local manager of the Bell Telephone Co. here.

Raise up the Bartlett Rope—Pull Tree Trimmer and it Becomes Easy to Trim High Branches Quickly and Safely.

Valuation in Rate Making

Chapter IV—Regarding the Inventory.

By Charles W. McKay

In the last installment of this series, we considered the correlation between telephone accounting and telephone appraisement. It will be remembered that certain definite procedure is specified, by most of the state commissions, for classifying telephone property, and, furthermore, that such inventory classifications are predicated upon the requirements of the telephone accounting systems.

In the present installment, we have reached an intensely practical phase of the subject of "Valuation in Rate Making"; i. e. the recording of the inventory of plant and equipment. As a correlary to the problem of inventory taking we have the problem of determining the actual present condition of the telephone property—as is, at the date of appraisement. In other words, in order to determine the present, or depreciated, value of property, we must carefully examine each item of telephone plant and equipment to ascertain the accrued depreciation. Naturally, in practical appraisal work this task is performed in conjunction with the task of recording the descriptive data relative to the various items of telephone property. One does not make a careful inventory of plant and equipment, and subsequently revisit all portions of the property in question for the purpose of determining the present condition of property items which have already been inventoried.

However, for our present purpose, we will first consider the problem of inventory and, subsequently, the problem of determining present condition. It is thought that the subject may be presented more clearly in this way. The reason for this will be obvious when it is remembered that the problem of determining present condition must be predicated upon a thorough understanding of a rather involved phase of our subject; i. e. the question of depreciation. Hence we will discuss inventory methods first; in a subsequent installment the theory of depreciation will be presented in detail, and this, in turn, will be followed by intensely practical suggestions as to ways and means of satisfactorily determining the actual present condition of telephone property as found at the date of appraisement. Then, when the reader undertakes the solution of his own valuation problems, he can review this chapter together with the depreciation chapters, and so mould his field methods as to facilitate the coincident recording of inventory data and the determination of present condition.

As a preface to this chapter on inventory methods, it may be well to form a mental picture of the plant as a whole. It is thought that a consid-

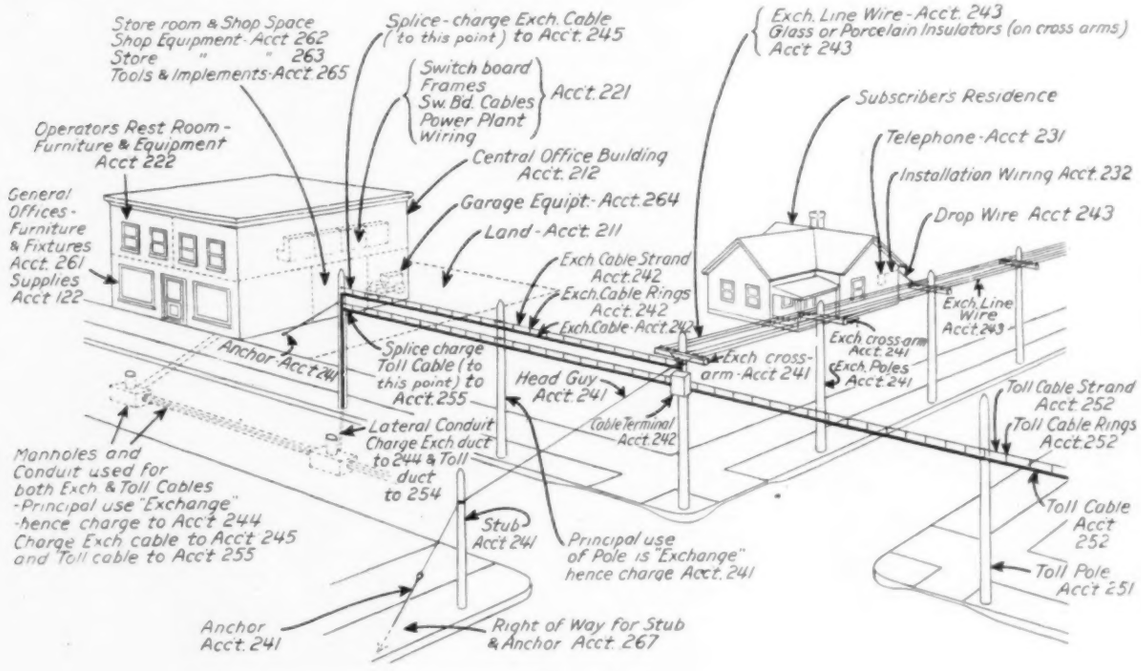

Store room & Shop Space
Shop Equipment - Acct 262
Store " " 263
Tools & Implements - Acct 265
Splice - charge Exch. Cable (to this point) to Acct. 245
Switch board Frames
Sw. Bd. Cables
Power Plant Wiring
Acct. 221
Exch. Line Wire - Acct. 243
Glass or Porcelain Insulators (on cross arms) Acct 243
Subscribers Residence
Telephone - Acct 231
Installation Wiring Acct 232
Drop Wire Acct 243
Operators Rest Room - Furniture & Equipment Acct 222
Central Office Building Acct. 212
General Offices - Furniture & Fixtures Acct. 261
Supplies Acct 122
Garage Equipt - Acct. 264
Land - Acct. 211
Exch Cable Strand Acct. 242
Exch. Cable Rings Acct. 242
Exch. Cable - Acct. 242
Exch. Line Wire Acct. 243
Exch cross-arm Acct. 241
Exch. Poles Acct. 241
Anchor - Acct. 241
Splice charge Toll Cable (to this point) to Acct. 255
Head Guy Acct. 241
Exch cross-arm - Acct. 241
Toll Cable Strand Acct. 252
Toll Cable Rings Acct. 252
Manholes and Conduit used for both Exch. & Toll Cables - Principal use "Exchange" - hence charge to Acct 244 Charge Exch cable to Acct 245 and Toll cable to Acct 255
Lateral Conduit Charge Exch duct to 244 & Toll duct to 254
Cable Terminal Acct. 242
Stub Acct 241
Principal use of Pole is "Exchange" hence charge Acct. 241
Toll Cable Acct 252
Toll Pole Acct 251
Anchor Acct. 241
Right of Way for Stub & Anchor Acct. 267

Fig. 4

Illustration of Component Elements of Telephone Plant - Showing Classifications under the I.C.C. System.

Ray-O-Vac
B Battery No. 4151
Extremely compact and light. Built specially for airplanes and portable sets. Weighs only one pound; yet it is full 22.5 volts. List $1.75. Spring connections optional.

Ray-O-Vac — *Special B Battery No. 2151*
For stationary sets. With one common negative terminal voltages from 12 to 22.5 can be obtained. By varying both negative and positive wires, low voltages from 1½ to 10½ can be obtained. List $3.00. Also furnished with spring connections.

Ray-O-Vac
B Battery No. 5151
For portable sets. Compact and full-powered. This is the type standardized by U. S. Navy. Voltage adjustment 18 and 22.5 volts. List $2.25. Spring connections if desired.

Ray·O·Vac Long Life B-Battery *for all types of* Radio Sets

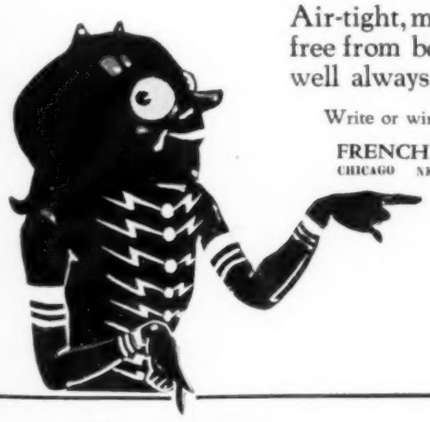
Developed by battery experts in the laboratories of the French Battery & Carbon Company at Madison, Wisconsin, manufacturers of the famous French Telephone Cells, Ray-O-Vac Batteries now ready for delivery.

Each battery consists of fifteen cells assembled as a solid unit and treated with special insulating compound to eliminate induced current and noises in receiving.

Air-tight, moisture-proof containers keep Ray-O-Vacs free from bothersome weather changes. They work well always.

Write or wire for delivery dates and discounts, or ask your jobber.

FRENCH BATTERY & CARBON CO., *Madison, Wis.*
CHICAGO NEW YORK MINNEAPOLIS KANSAS CITY ATLANTA DALLAS DENVER



Ray-O-Vac
Baby B Battery No. 531W
3 cell, 4 5-10 volts for use where standard 15 cell batteries are not practical—and for boosting voltage after battery has been used for considerable period. Weighs 4 ounces. List 40c.

French TELEPHONE BATTERIES

eration of Fig. 4 will aid the reader in visualizing the entire problem. Fig. 4, it will be noticed, shows the various component elements of a telephone property, and gives the proper classifications—under the uniform system of accounts as prescribed by the Interstate Commerce Commission.

Starting with the Central office, at the left of the illustration, it will be noted that the land; upon which the office is located, is chargeable to Account 211; the building to Account 212; the telephone switchboard to Account 221; the auxiliary central office equipment to Account 222. Both the central office equipment (Account 221) and the "other equipment of central offices" (Account 222) are, in reality sub-accounts to the general central office equipment account No. 220.

All central office switchboard cables between switchboards main and intermediate frames—are charged to Account 221. However, the cables from the frames to the "pot-head" splices are not charged to the central office accounts, but are charged to the underground cable account—245.

The conduit from the office to the office manhole, and of course all conduits and manholes beyond this point are charged to the underground conduit account No. 244. As an exception to this case, conduits and manholes—at the central office—where such conduits and manholes have been built at the same time as, and as a part of, the building itself, are included with the building account—No. 212.

As shown in the illustration, the lateral, or subsidiary conduits—from manholes to poles or buildings—are included in underground conduit account No. 244. In a similar manner, lateral cables—cables from manholes to poles or buildings—are charged to the underground cable account No. 245. In cases where such cables terminate in "cross-connection" or terminal boxes, there is little difficulty in establishing their identity. However, in some cases lateral cables are spliced directly to aerial cables. In such cases the cable from the manhole to the point of first splice will be inventoried as underground cable—and all cable beyond this point will be inventoried as aerial cable (account 242).

Following the distribution plant from the central office, it will be noted that all supporting strands and means of attaching aerial cables to strands (either of the marlin or ring type) are to be inventoried, and classified with, the aerial cable account No. 242. Also, terminals on aerial cables are chargeable to the aerial cable account, and are to be included in this portion of the inventory classification.

Again referring to the illustration, where but few subscribers are to be cared for, aerial wire is frequently used in lieu of aerial cable. The wire is chargeable to "exchange aerial wire", Account 243. A most important precaution to be observed in connection with the inventory of the aerial wire plant is the following—all insulators (either glass or porcelain) and all wires used for tying the line wires on to these insulators are chargeable to the aerial wire account, and should be so inventoried. Some appraisers make the mistake of classifying insulators with the cross-arms to which they are attached. Furthermore, the "drop" or "service" wires—extending from the line wire to the subscribers' premises are included in the aerial wire account—although they are usually segregated (as a subdivison of this account) in recording the inventory data. A notable exception to this case is where twisted pair (say No. 17 copper clad steel) is used in lieu of line wire. Sometimes several hundred feet of twisted pair will be extended from a terminal (over two or more poles) to the subscribers' premises. A good rule for affecting a proper segregation in this case is to classify the wire from the protector block on the subscribers' premises to the nearest pole as "drop" wire, and the rest of the circuit as line wire. At first thought—due to the fact that both drop and line wire are ultimately chargeable to the same account (Account 2243)—it may seem foolish to worry over such hair-splitting distinctions. However, when we come to the subject of "unit-costs", it will be noted that there is a great difference between the cost of stringing line wire and installng service "drops".

Again referring to Fig. 4, it will be noted that all poles, cross arms, guys, stubs, and anchors are charged to the general pole line account—No. 241. However, in recording the inventory, it is most essential that these various items shall be segregated. The reason for this will be obvious when one considers the fact that the installation costs very widely and individual unit costs must be evolved for each of these sub-clasifications of the pole line account.

At the subscribers' premises, all of the equipment is charged to general account No. 230—but in this case, also, certain distinctions must be made. The wire from the protector, or connection, block to the instrument must be inventoried as "Station installations, sub-account 232". If there is a private branch exchange on the property, this, together with the cabinet used for cross-connection purposes, must be classified under sub-account No. 234 "Private branch Exchanges". If there are telephone booths on the premises—these booths together with their fittings must be inventoried separately and classified as "booths and special fittings" Sub-account 235. The station apparatus itself—all main and extension stations—falls under the category "station apparatus" Sub-account 231.

For illustrative purposes, it will be noted that all cables and poles have been included in the illustration—and the proper accounts designated.

It is thought that Fig. 4 will present, pictorially, a resume of the inventory problem. If the reader contemplates the undertaking of a specific inventory task, it is suggested that he review, carefully, the preliminary inventory steps referred to in the previous installment—Chapter II.

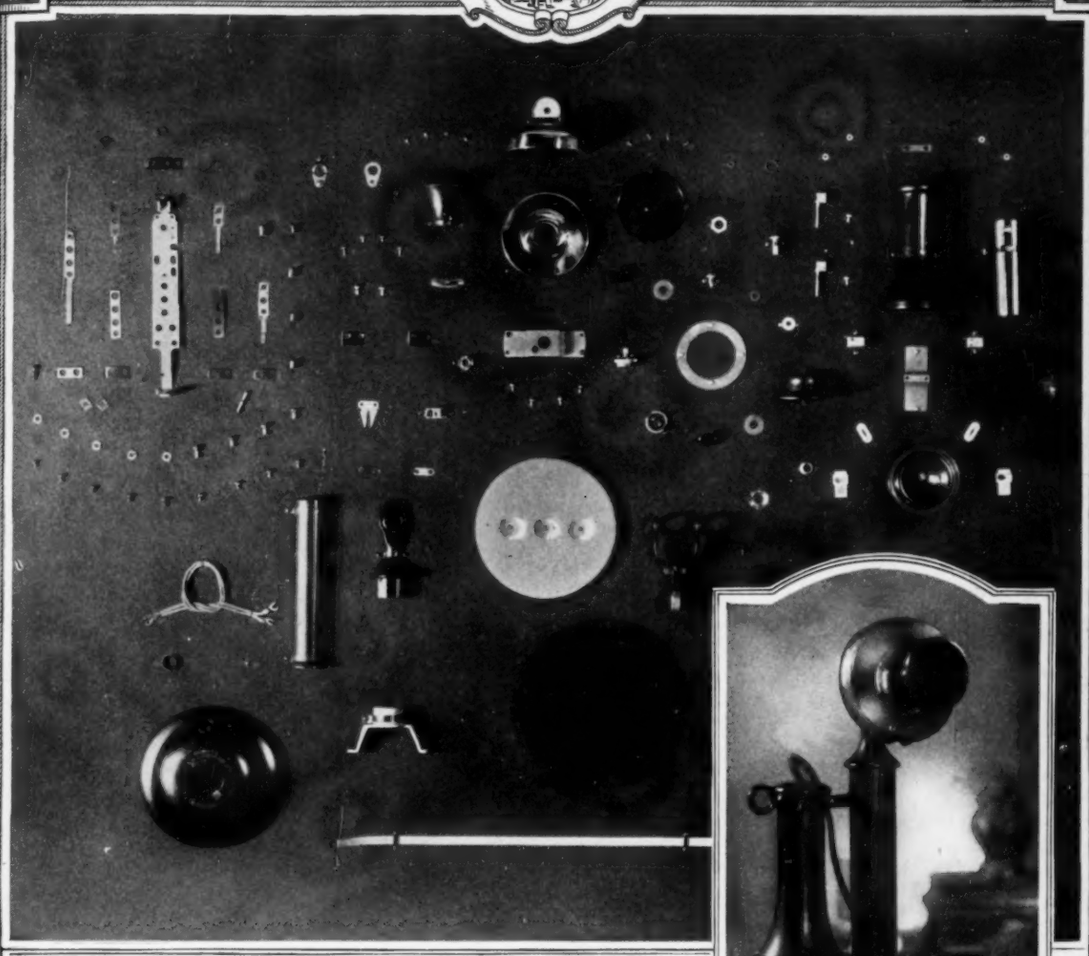
Having paved the way for the actual work of inventory—by selecting men who are qualified for the various inventory tasks; having obtained all maps and records which will be helpful in recording the inventory—we are ready to tackle the problem of preparing suitable forms for recording inventory data.

Let us first consider the preparation of forms suitable for recording pole and wire data. Fig. 5 illustrates a form, which has been used frequently by the writer, with satisfactory results. It will be noted that a column is provided for indicating the pole number—and also, for further identification purposes, columns are included for specifying the exact location of the pole; i. e. (referring to Fig. 5) the first entry is Pole No. 22, and the location is described as follows: "On Ave. A between 1st and 2nd Sts."

The form suggested in Fig. 5 should be used in conjunction with a keymap of the general form illustrated in Fig. 6.

As a suggestion for the use of the form illustrated in Fig. 5—conjunction with the keymap illustrated in Fig. 6—the writer offers the following specific instructions:—

1. Locate the poles, as accurately as possible (with respect to property



Yet all these parts make just one telephone

To most people a telephone is merely a place to talk into and a thing that you hold to your ear. As a matter of fact two hundred and one separate parts are needed to make one telephone.

This complexity calls for an accuracy in construction comparable with that demanded by the finest watch. Remarkable precision is necessary because your telephone must catch a most elusive thing—the subtle differences in inflection of the human voice.

To build such an instrument takes skill. The ability to make it better and better as the standards necessarily became higher was achieved only through years of accumulated experience. The Western Electric Company has been making telephones since 1877—one year after the telephone was invented.

Western Electric

Since 1869 Makers of Electrical Equipment

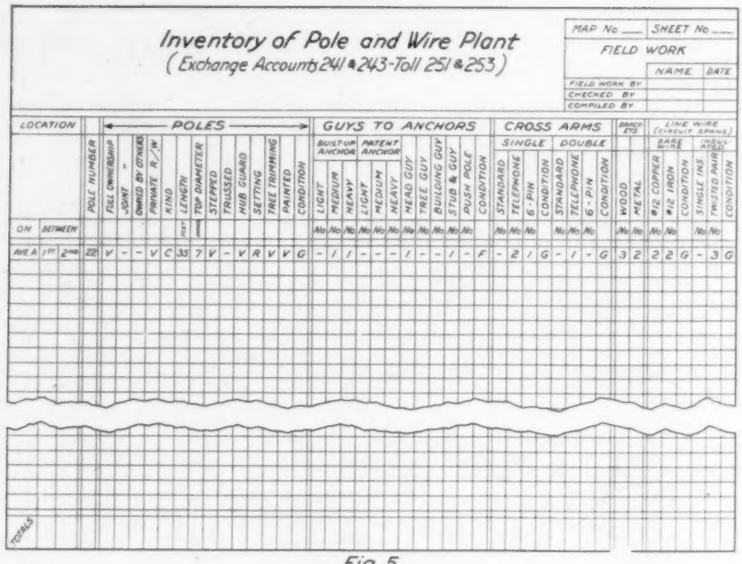


Fig. 5
Sample of Field Form for Pole and Wire Plant

lines, street and alley intersections). Note only poles belonging to foreign companies (electric light companies, etc.) upon which the wires of your company are attached. Code such foreign poles as to distinguish them from your own poles—See Fig. 6.

2. Poles should be numbered consecutively, as they are recorded, beginning with the No. "1" on the field map—unless it is desired to adhere to a previously installed stenciled numbering system.

3. A separate line on the inventory data sheet (Fig. 5) should be used for each pole recorded. If you do not own the pole in question, the columns provided for the pole data may be left blank, and the information as to cross arm and wire data recorded in the spaces provided therefor.

4. Use some code—such as "C" for cedar, "Ch" for chestnut, etc.—to denote the material of the pole, in the column headed "kind".

5. For each pole, under the column headed "setting", a suitable notation should be made to distinguish between poles set in sandy soil, poles set in pavement, poles set in rocky soil, etc. The letter "D" may be used for ordinary soil, letter "P" for pavement, and the letter "R" for rock.

6. All data as to special equipment, such as hub guards, cribbing guards, special reinforcement, and all data as to anchors and guys should be noted in the columns provided therefor—in the sample form illustrated in Fig. 5.

It will be noted that a column is provided for "Condition". As previously suggested, the subject of determining the present condition of telephone plant will be discussed in a subsequent installment. It may be said, however, that such designations as "E" for poles in excellent condition, "G" for poles in reasonably good condition, "F" for poles in fair condition, and "P" for poles in very poor condition, are frequently used. (Chapter 6 to be continued in June issue).

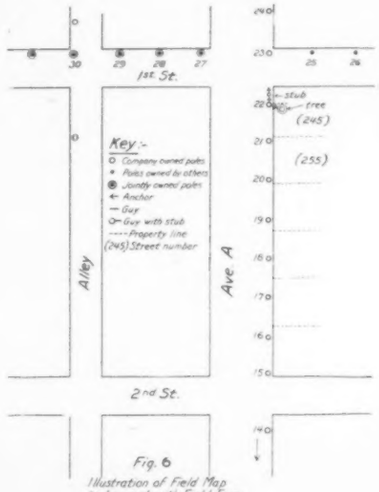


Fig. 6
Illustration of Field Map to be used with Field Form
(Part of map only shown in this illustration.)

Sweden and Finland to Get Radio Phone Bond.

Stockholm, Sweden—A radio telephone system to take the place of the contemplated telephone cable between Sweden and Finland now is being investigated by officials of the two governments involved. Estimates place the cost of the cable from 20,000,000 to 40,000,000 marks and the radio station at 1,000,000 marks.

Home at Fort Wayne Busy With Construction Plans.

Fort Wayne, Ind.—Frank E. Bohn, general manager of the Home Telephone and Telegraph Co. says several hundred thousand dollars will be spent in carrying out the company's improvement plans, $75,000 to be devoted to underground construction on the main streets, within two miles of the central office. An extensive toll line construction and reconstruction program has been inaugurated. About 25 miles of poles will be reset this summer. Two new White trucks for long distance construction work have arrived, making 29 trucks in the Home Co.'s fleet.

Service Will Be Held Per Usual —Church Made Exchange.

Washington, Ill.—St. John's Lutheran church, erected in 1869, has been bought by the Home Telephone company at public auction and will be rehabilitated for use as a telephone exchange.

New Capital—Recent Incorporations of Telephone Companies.

Potter, Wis. — Rantoul Telephone Co. Capital, $8,000. Incorporators: Henry J. Wunrow, Theodore Zahn, and William Lorche, all of Potter.

Barnard, S. Dak. — Barnard Telephone Co. Capital, $22,500. Directors: H. B. Fest, C. M. Diedee, George Ellicott, and W. D. Atkins, of Frederick, and Philip Grantz of Barnard.

Ashland, Ky. — Consolidated Telephone Co. of Carter County. Capital, $2,000. Incorporators: W. A. Sammons, Albert Parsons, and J. A. Van Hoose.

Killbuck, O. — Home Telephone Co. has increased its capital from $10,000 to $20,000.

Reeedsville, Wis.—New Rockland Telephone Co., Capital, $5,000. Incorporators: John W. Mahnke, F. J. Baboltz, and W. C. Maertz, all of Reedsville.

$10,000,000 Ohio Bell Growing Pain Cost for 1922.

Cleveland, Ohio—About $10,000,000 will be spent in 1922 carrying out the Ohio Bell's construction plans. Unification of service at 30 points, a gain of 17,000 stations, and rebuilding the reserve supply of materials are the high spots of the current year's budget.

As fast as telephone service has expanded, battery requirements have become more exacting. The demand now is for a battery to endure not only ordinary use, but extraordinary abuse; to recuperate quickly after a hard session; to take absolute rest while the family's out; to live and serve for a long, long time. Telephone men always specify Columbia Gray Labels because they give better service for a longer time—they cost less per month of service. Fahnestock Spring Clip Binding Posts at no extra cost.

NATIONAL CARBON CO., Inc.
LONG ISLAND CITY, N. Y.
Atlanta Cleveland Chicago
Kansas City San Francisco
Canadian National Carbon Company, Limited, Toronto

Columbia
Telephone Batteries
"less cost per month of service"

NEW BATTERY CHARGER.

Westinghouse Company Brings Out New Rectifier for Radio Batteries.

A new battery charging rectifier called the Rectigon Battery Charger has been brought out by the Westinghouse Electric and Manufacturing Co. This set is particularly adapted for charging the radio battery but telephone men might also find it useful for charging storage battery where they are used on operators transmitters in smaller offices. The battery charger is made in two sizes which will deliver current at from six to fifteen volts. The smaller size charges at a 2 ampere rate and the larger size at a six ampere rate. It is claimed that the cost will not exceed .8 and 1.5 cents per hour respectively.

Some of the distinctive features are light weight and automatic operation. There are no moving parts and all that is necessary to charge the battery is to snap the clips on the battery terminals and turn on the switch at the lamp socket to which the set is connected. If the current is interrupted on the alternating current line the line voltage will stop charging but will resume as soon as the current is restored.

Baltimore Stirred By News of Bell Radio Station.

Baltimore, Md.—Selection of Baltimore as the site of a great radio broadcasting station for Baltimore and Washington territory has aroused much interest here. Completion of the $1,000,000 Bell broadcasting station in New York and the installation of other A. T. & T. radio stations in metropolitan centers, as slated for the immediate future, gives the Bell an early start as a big factor in radio telephony.

Asheville, N. C., Gets 50,000 In Service Improvements.

Asheville, N. C.—According to M. A. Erskine, district manager for the Asheville Telephone and Telegraph Co., more than $50,000 will be spent during the summer in expanding the facilities of the local company in growing parts of the city. Toll testing equipment also is to be brought up to present requirements.

WANTED.

One copy of TELEPHONE ENGINEER for October, 1920. Will extend your subscription three months for this copy.

Advertising Follow-up on Phone Week Has Unique Copy.

Boston, Mass.—Telephone Week was such a big success with the New England Telephone and Telegraph Company, that the organization continues to play it up in its newspaper advertising. The marvels of the plant are explained in detail in an interesting series of advertisements, all of which are headed, "Did You Visit Us?" The campaign brings the exchange to its subscribers in a most interesting manner, as may be seen from the two accompanying reductions of New England advertisements.

DID YOU VISIT US?

Perhaps You, Too, Would Be Interested to Know How Telephone Operators Interpret Light Signals

DID YOU VISIT US?

Maybe You Are Troubled With Wrong-Number Calls and Could Get or Contribute Some Suggestion if You Came

Remind Exchange Visitors of Marvels They Saw by Live Advertising

O-P-E-R-A-T-O-R

I welcome every *O*pportunity for service.
I *P*ersevere in my attemps to give satisfaction.
I am *E*ager to assum my share of responsibility.
I am *R*eliable and can be depended upon in times of emergency.
I am *A*mbitious to win and maintain goodwill on behalf of my company.
I am *T*rustworthy and do not blind myself to duty.
I am *O*bservant of means to further the interests of the public.
I am *R*ewarded by the knowledge that I have given my best to my job.
Who am I?
I am the O P E R A T O R !

F. W. Leypoldt, in LONG LINES

Book Review — New Works on Radio Equipment.

Construction of Radiophone and Telegraph Receivers, by M. B. Sleeper, Norman W. Henley Co., New York.

This popular priced book attempts to explain how radio receiving sets may be constructed rather than why they operate. It is a book for the beginner who wishes to secure a set that will operate and prefers to undertake the construction himself instead of purchasing the complete set from a dealer. Starting out with the construction of the antenna it gives the construction of various types of set ranging from simplest type of tuning coil with crystal detector to the complete set with audion detector and several stages of amplification. The real enthusiast, in all probability will not stop until he has constructed the regenerative receiver and two stage amplifier described in chapters 12 and 13. The book has a large number of illustrations and while not all details of the construction of the various parts are given, all essential information seems to be given so that the constructor can work out his own design from the data given.

"Radio Phone Receiving;" D. Van Nostrand Co., New York City; $1.50; is announced by its publishers as "a practical book for everybody"; written by nine specialists, headed by Michael I. Pupin; an excellent popular treatise on construction and receiving; simplified by numerous illustrations.